The world's most comprehensive encyclopedia of the military weapons of the 20th century

WAR MACHINE

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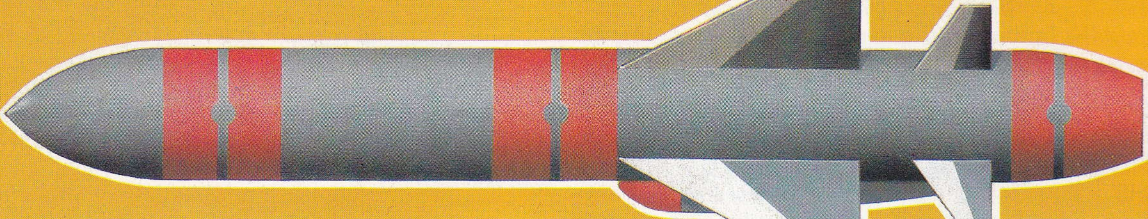

Armed Forces of the World: French Air Force (Part 1)

Anti-ship Missiles in the Falklands

Harpoon in Operation

NATO's defences against the anti-ship missile

The Soviet anti-ship missile threat

A fully illustrated guide to the world's Anti-ship Missiles

12 PAGE

WAR MACHINE

Volume 3 **Issue 25**

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Armed Forces of the World

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War Machine
Aerospace Publishing Ltd
10 Barley Mow Passage
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Managing Editor: Stan Morse
Editorial: Trisha Palmer
Chris Bishop
Chris Chant

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Artists:
Dave Etchell
Art Workshop
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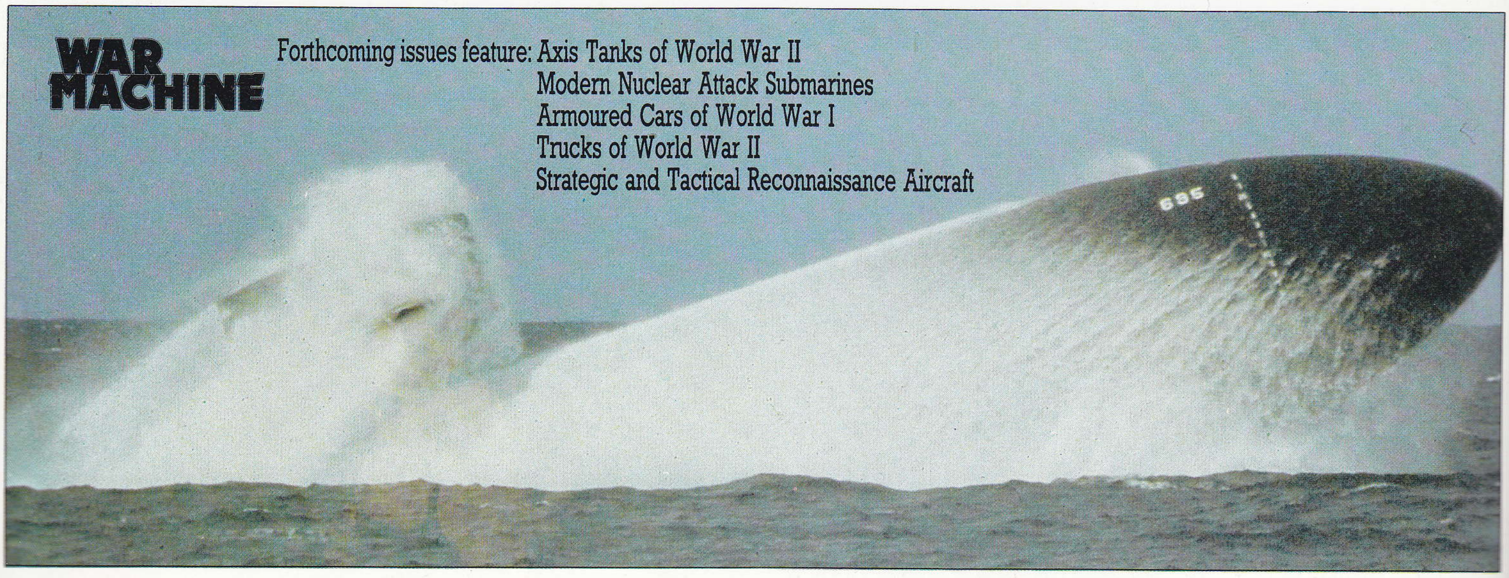
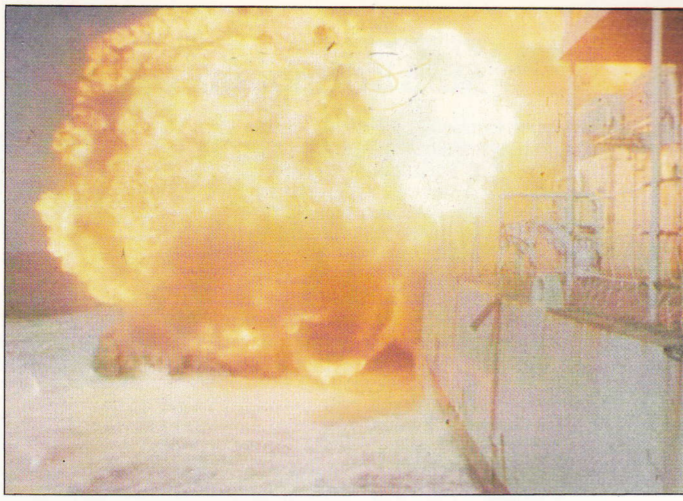


WAR MACHINE

Forthcoming issues feature: Axis Tanks of World War II
Modern Nuclear Attack Submarines
Armoured Cars of World War I
Trucks of World War II
Strategic and Tactical Reconnaissance Aircraft

Anti-ship Missiles



A typical mobility kill hit. The damage caused would be sufficient to stop the ship dead in the water but not to sink it.

The anti-ship missile has in recent years become the weapon with which small nations are able to challenge the supremacy of the naval superpowers. The 1982 events in the South Atlantic have seen theory become practice to great effect.

The role of the anti-ship missile is simply to prevent the target it hits from fulfilling its allotted role. The missile can do this in one of three ways: by causing a mobility kill, by effecting a weapon/sensor kill, or by sinking it. In the first case the idea is to deprive the enemy ship of its ability to move, either by destroying the engine facilities or by causing such damage that the ship is unable to move under its own power without the risk of sinking. In the second case the missile is targeted in such a way that it will explode either amongst the ship's external weapons and sensors such as radars (thereby destroying their ability to function) or actually within the ship's command, control and communications nerve centre (thus effectively paralysing the ship's fighting ability). In the third case the weight of the warhead is usually so great (above 500 kg/1,102 lb or so) that the resultant explosion causes such catastrophic damage that the ship has no hope of staying afloat. It is the USSR which subscribes to the last concept by fielding a huge variety of ship-, submarine- and air-launched anti-ship missiles that the West cannot match. However, where the West is ahead is in the numbers and types of weapons with which it fulfils the first two concepts. The recent Falkland Islands war and the continuing battle in the Arabian Gulf between Iran and Iraq have proved a number of weapons in battle. These and the other conflicts in which anti-ship weapons have been employed have also proved to the world that the nation with a small navy and air force can stand up to others with larger forces on equal terms if it is equipped with anti-ship missiles, as it reduces the threat of 'gunboat diplomacy'. The mere threat of Iran closing the Gulf to oil tanker traffic is one such example; on the other side of the coin, however, a nation can enforce its will on a number of others by using the anti-ship missile as a political weapon.

Thus the advent of the anti-ship missile is not just that of a new weapon type but something considerably more. It is in this light that the lists of operator countries of the various types should be studied closely, especially with regard to the political stability of the areas in which the countries are to be found, as it is certain that these missiles will see a lot more use in the years to come.

The MBB Kormoran uses an active or passive radar-homing seeker mode to target itself on a point just above the waterline of its victim.

WEST GERMANY

MBB Kormoran

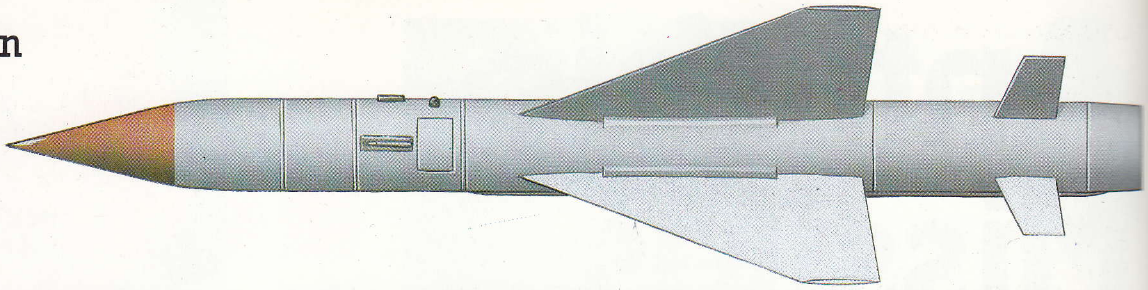
Designed to meet a 1964 West German naval air arm (Marineflieger) requirement, the **MBB Kormoran** was originally based on a French Nord design, the **AS.34**, using the inertial guidance system from the defunct **AS.33** project. However, following the creation of the German MBB aerospace consortium, the missile became a major project with help from the French concern Aérospatiale. The weapon was given a new and more sophisticated guidance package, and the first flight trials were undertaken on 19 March 1970, the first production rounds being delivered in December 1977. By the middle of the following year MFG 2, equipped with Lockheed F-104G Starfighters, was fully operational with the missile at Eggbeck. Normally two missiles are carried under the wings of the F-104G, whilst the newly-introduced Panavia Tornados of the Marineflieger can carry four, although a maximum of eight is possible. The Kormoran is also operated by the Italian air force.

After release from the launch aircraft, two double-propellant SNPE Prades boost motors burn for about one second, then the main SNPE Eole IV sustainer motor cuts in to provide thrust for a further 100 seconds of powered flight. For the initial cruise phase of the mission a Stena/Bodenseewerk inertial guidance platform coupled with a modified TRT radio altimeter is used to hold the missile on course (using the cruciform rear fins) at a height of about 30 m (100 ft). Near the estimated target location the missile is commanded to descend to its wave-top attack altitude by the autopilot, and the Thomson-CSF two-axis radar, acting in either a pre-set active or passive mode, searches for, acquires and then locks on to the enemy vessel. The missile then strikes the target just above the waterline, the warhead (with 56 kg/123.5 lb of explosive, delay-action fuse and 16 radially-mounted charges) explodes deep within the hull to maximize the damage caused.

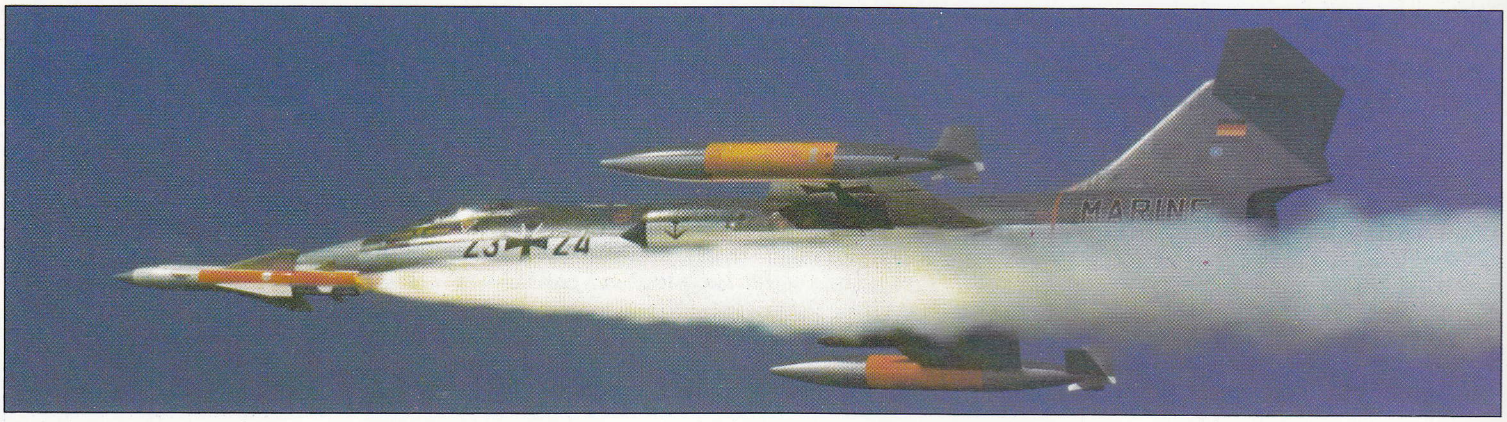
The development of a **Kormoran Mk 2** version for the Marineflieger has begun, and this is expected to have an improved radar seeker with enhanced ECM resistance, a longer range and a heavier and more destructive warhead.

Specification

Kormoran
Dimensions: length 4.40 m (14 ft 5.25 in); diameter 34.4 cm (1 ft 1.5 in); span 1.00 m (3 ft 3.4 in)
Weights: total round 600 kg (1,323 lb); warhead 165 kg (364 lb)
Performance: maximum speed Mach 0.95; range 37 km (23 miles)



Designed in the late 1960s, the first production rounds of the Kormoran were not delivered until 1977. A Mk 2 version is already under development for the West German navy to arm its Tornado strike aircraft in the mid to late 1990s.



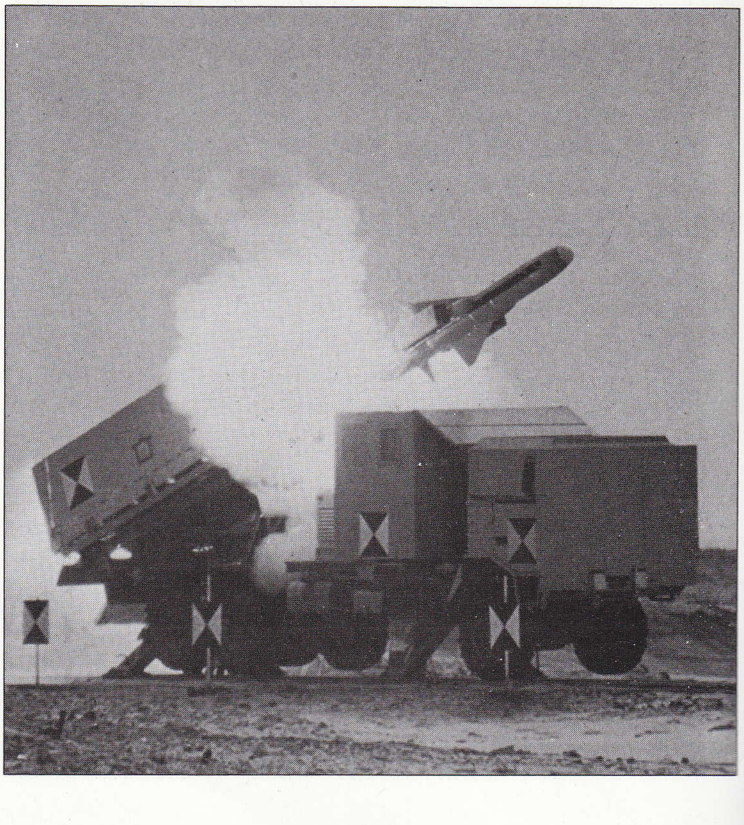
The Kormoran Mk 1 is used by the Marineflieger and by Italian anti-shipping units. It is specifically designed to operate amongst the Baltic coastal islands, which would normally provide any potential enemy vessels with adequate radar cover.

ITALY/FRANCE

OTO-Melara/Matra Otomat

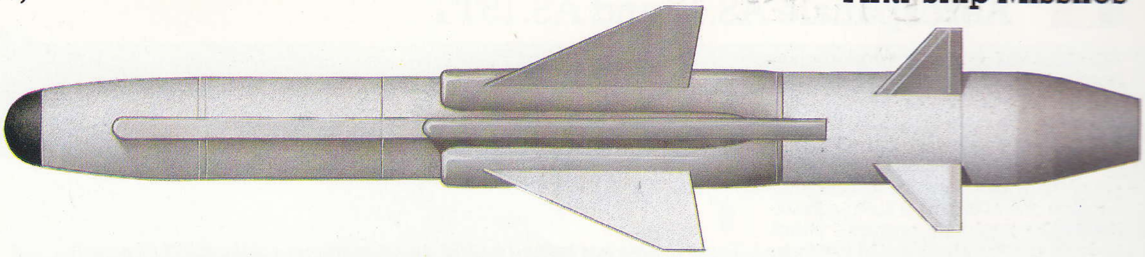
Developed as a joint venture by OTO-Melara of Italy and Matra of France, the **Otomat** missile is powered by a Turboméca turbojet and is carried in a self-contained container-launcher unit. Two lateral jettisonable solid-propellant boosters are attached for the launch phase, boosting the missile to cruising speed. Initial target-location data is gained from either the launch platform's own sensors or external sources such as helicopters or other ships. The missile is then launched at an angle of up to 200° from the target's actual bearing, corrects its heading (with an autopilot controlling the cruciform rear fins) and climbs to its cruising altitude of 250 m (820 ft). At a predetermined point the missile then descends to 20 m (66 ft) above sea level and, when about 15 km (9.3 km) from the target's expected location, commences a search with its terminal active radar seeker. Once acquisition and lock-on are achieved, the missile descends to the final altitude of 10 m (33 ft) for the run in to the target. If the Italian SMA homing head is fitted then the missile stays as a sea skimmer until impact; if, however, the French Thomson-CSF 'col-vert' head is fitted, the missile undertakes a rapid climb to 175 m (574 ft) and then dives on to the target. In the Italian navy's **Otomat Mk II Teseo** version, a Marconi Italiano TG-2 command guidance system is fitted for mid-course guidance correction by airborne platforms. This allows targets to be engaged at ranges in excess of 180 km (112 miles). Otomat operators are Algeria, Egypt, Italy, Libya, Nigeria, Kuwait, Peru, Saudi Arabia and Venezuela.

A coastal-defence variant of the Otomat has also been developed, and this version has been acquired by Egypt in addition to the ship-launched system. Italy is also developing a supersonic successor to the Otomat known as the **Otomat 2.** This will probably incorporate new seeker technology and enter service in the late 1980s.



Designed to be used with an external target-designating source to get the maximum benefit from its range capabilities, the Otomat has yet to see combat service, although its presence in the inventories of several Middle Eastern countries may change this.

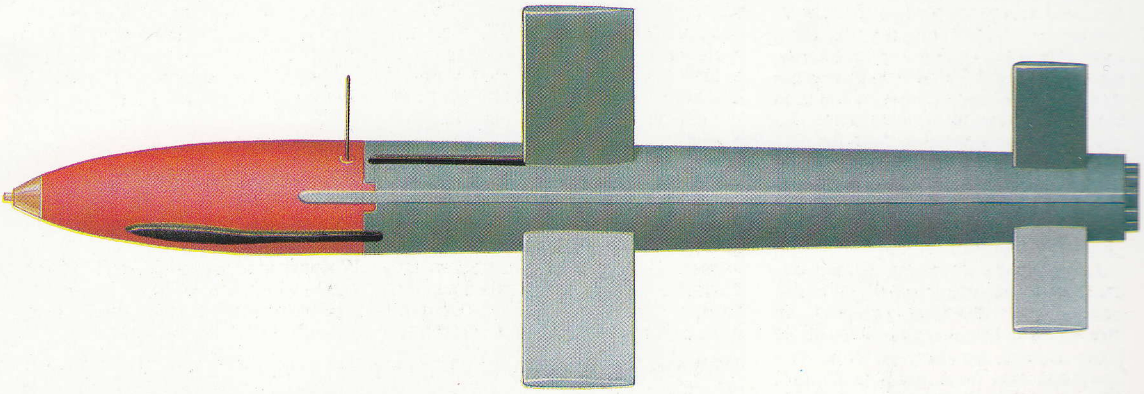
Specification
Otomat
Dimensions: length 4.82 m (15 ft 9.75 in); diameter 46.0 cm (1 ft 6.1 in); span 1.19 m (3 ft 10.85 in)
Weights: total round 770 kg (1,698 lb); warhead 210 kg (463 lb)
Performance: maximum speed Mach 0.9; range 60 km (37.3 miles) as a single missile or 80 km (50 miles) when fired in salvo



The Otomat is found in both coastal defence and shipborne versions.

ISRAEL

IAI Gabriel



The Gabriel is available in three marks for shipboard use by Israel.

Developed in the mid-1960s as the main armament for the 'Saar' class of missile craft, the **Israel Aircraft Industries Gabriel** has been proved to be one of the most successful anti-ship missiles ever used in combat. During the 1973 'Yom Kippur' war it was responsible for sinking a large number of Arab warships and neutral merchantmen. The missile is carried in a reinforced glassfibre container-launcher that can be mounted either in fixed single or in trainable triple cell units. Before launch the missile's guidance system is programmed with target data obtained from the launch platform's own sensors. The missile is then fired and, under control of its twin gyro system and radio altimeter (working on the cruciform rear fins), assumes a cruise flight profile to the target area. The initial part of this trajectory is flown at around 100 m (330 ft) with a programmed descent to 20 m (66 ft) for the major part. At a range of 1-2 km (1,095-2,190 yards) from the estimated target position the missile switches on its seeker, acquires the target and descends to one of the three pre-set terminal attack heights of between 1 and 3 m (3 and 10 ft) for the attack, the actual height being dependent on the sea state encountered. In the case of the **Gabriel Mk I** and **Gabriel Mk II**, terminal homing is carried out by a semi-active radar seeker that relies on target illumination by the I-band target designator radar of the launch platform, although a manual/optical control system and a command guidance with radar tracking mode are also available. In the **Gabriel Mk III** homing is by an I-band frequency-agile active radar system, which allows a fire-and-forget mode to be employed; the other two guidance options are also available for use. The Gabriel shipboard system is designed to permit the use of all three versions in a single ship, the different characteristics of each type allowing maximum flexibility in mission planning. The surface-launched Gabriel Mk I and Mk III are operated only by Israel, while the Gabriel Mk II is also used by Chile, Kenya, Singapore, South Africa, Taiwan and Thailand.

In the early 1980s the Gabriel Mk III was developed into two air-launched variants for use by the Israeli air force on its McDonnell Douglas Phantom, McDonnell Douglas Skyhawk, IAI Kfir, General Dynamics Fighting Falcon and IAI Sea Scan aircraft. The basic **Gabriel Mk III A/S** version has a range of 40 km (25 miles), whilst the **Gabriel Mk III A/S ER** extended-range version has a lengthened sustainer motor within the existing body to give a range of 60 km (37.3 miles). Both have the same capabilities for fire-and-forget and fire-and-update launch modes as the original Gabriel Mk III. Only Israel operates the air-launched Gabriel Mk III models.

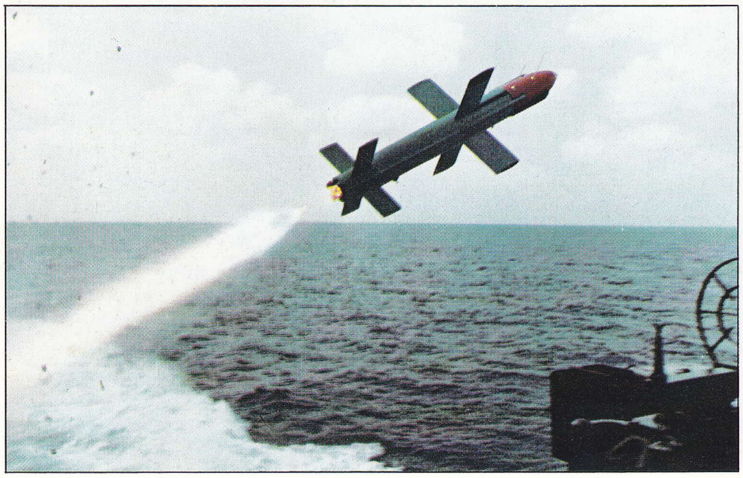
The Gabriel is known to be built under licence by two countries, South Africa (as the **Skorpioen**) and Taiwan (as the **Hsiung Feng**, or male bee).

Specification
Gabriel Mk I
Dimensions: length 3.35 m (11 ft 0 in); diameter 34.00 cm (1 ft 1.4 in); span 1.38 m (4 ft 6.33 in)
Weights: total round 431 kg (950 lb); warhead 180 kg (397 lb)
Performance: maximum speed Mach 0.65; range 21 km (13 miles)

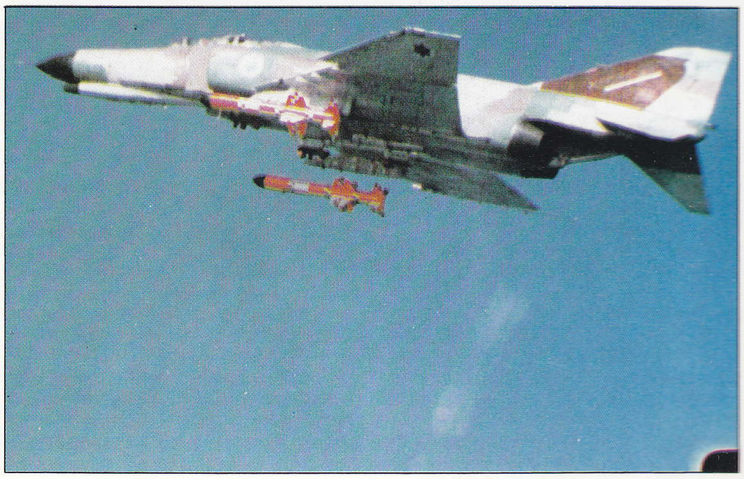
Specification
Gabriel Mk II
Dimensions: length 3.42 m (11 ft 2.65 in); diameter 34.00 cm (1 ft 1.4 in); span 1.34 m (4 ft 4.75 in)
Weights: total round 522 kg (1,151 lb); warhead 180 kg (397 lb)
Performance: maximum speed Mach 0.7; range 26 km (22.4 miles)

Specification
Gabriel Mk III
Dimensions: length 3.81 m (12 ft 6 in); diameter 34.00 cm (1 ft 1.4 in); span 1.34 m (4 ft 4.75 in)
Weights: total round 558 kg (1,230 lb); warhead 150 kg (3331lb)
Performance: maximum speed Mach 0.7; range 40 km (25 miles)

Specification
Gabriel Mk III A/S and Mk III A/S ER
Dimensions: length 3.84 m (12 ft 7.2 in); diameter 34.00 cm (1 ft 1.4 in); span 1.10 m (3 ft 7.3 in)
Weights: total round 558 kg (1,230 lb) for Mk III A/S and 600 kg (1,323 lb) for Mk III A/S ER; warhead 150 kg (331lb)
Performance: maximum speed transonic; range 40 km (25 miles) for Mk III A/S and 60 km (37.2 miles) for Mk III A/S ER



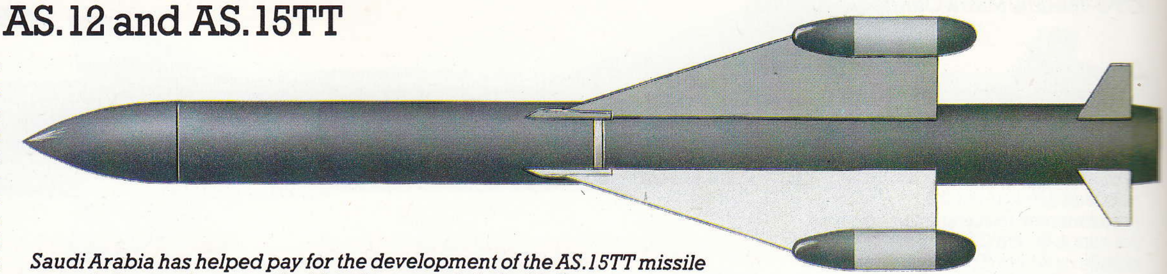
Using a variety of command-guided and semi-active homing techniques, the Gabriel Mk I was used extensively in the 1973 Yom Kippur War by the Israeli navy, and sank a number of Syrian and Egyptian craft.



The air-launched Gabriel Mk III was developed from the active radar terminal homing ship-launched Mk III to give the Israeli air force a potent anti-ship capability.

FRANCE

Aérospatiale AS.12 and AS.15TT



Saudi Arabia has helped pay for the development of the AS.15TT missile as part of a massive arms deal that they negotiated with France.

The **SS.12** was originally developed by Nord as a multi-purpose weapon. The air-launched version of the SS.12, the **AS.12**, was first produced in 1960 for carriage by the French navy's Dassault Etendard and Aérospatiale Super Frélon aircraft. However, the missile soon became one of the main air-to-surface weapons carried by maritime patrol aircraft and ASW helicopters such as the Lockheed Neptune, Breguet Atlantic, Aérospatiale Alouette, Westland Wessex and Westland Wasp. The solid-propellant AS.12 used a basic command wire-guidance system to cruciform fins with optical tracking via a set of flares in the rear of the missile, the major disadvantage being that the aircraft has to remain within relatively close range of the target whilst the missile is under guidance, and is thus highly vulnerable to enemy defensive fire. During the 1982 Falklands war the Royal Navy fired a number of AS.12s from Wasp helicopters at the Argentinian submarine *Santa Fé* off South Georgia; these did some damage to the fin and pressure hull and helped prevent the boat from submerging. The AS.12 is being replaced in Royal Navy service by the Sea Skua. The SS.12 has also been used as an anti-ship weapon on fast attack craft. Countries operating the AS.12 include Argentina, Chile, France, Iran, Iraq, Kuwait, Turkey, the UK, and the United Arab Emirates.

In the French navy the AS.12 is being replaced by the helicopter-launched solid-propellant command-guided AS.15TT (*tous temps*, or all-weather) missile. This relies on a radio link to cruciform rear fins for azimuth guidance, both the missile and target being tracked by the launch helicopter's Thomson-CSF Agrion 15 radar. The cruise height is between 3 and 5 m (10 and 16 ft) above the water, and is maintained by a radar altimeter. At around 300 m (330 yards) from the target the missile is commanded to descend to wave-top height in order to ensure a hit. The first complete test firing took place in October 1982, and Saudi Arabia has helped to pay for most of the development work. Both ship-launched and coastal-defence versions are also under development, and the only current customers are France and Saudi Arabia.

Above: A French navy Lynx helicopter fires a wire-guided AS.12 missile. A major disadvantage is that the Lynx has to stay within the defensive fire envelope of the target during guidance.

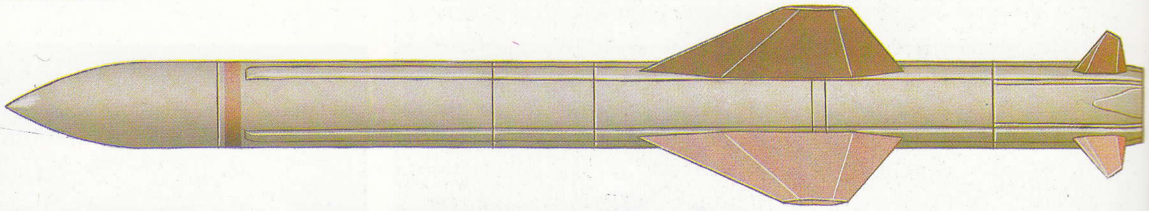
Specification
AS.12
Dimensions: length 1.87 m (6 ft 1.6 in); diameter 21.0 cm (8.25 in); span 65.0 cm (2 ft 1.6 in)
Weights: total round 76 kg (168 lb); warhead 28.4 kg (62.6 lb)
Performance: speed low subsonic; range 8 km (5 miles)

Specification
AS.15TT
Dimensions: length 2.16 m (7 ft 1 in); diameter 18.5 cm (7.3 in); span 56.4 cm (1 ft 10.2 in)
Weights: total round 96 kg (212 lb); warhead 29.7 kg (65.5 lb)
Performance: speed high subsonic; range 16 km (10 miles)

An SA-365F Dauphin 2 carrying a maximum load of four AS.15TTs. Being a command-guided weapon, the helicopter can use its search radar both to track the target and direct the missile, thus reducing its vulnerability to the target's defences.

FRANCE

Aérospatiale Exocet



The Exocet family is the most widely used of all Western anti-ship missiles.

Developed in the late 1960s to meet a French navy requirement, the **Aérospatiale Exocet** completed its first manufacturer's trials in mid-1972. In October of that year evaluation tests were undertaken by the French navy in conjunction with the Royal Navy and the West German Kriegsmarine. The results led to a missile improvement programme in 1973, the first production round being fired in the following year. Out of some 30 rounds fired the hit rate was 91 per cent. By early 1983 some 2,000 rounds of the various Exocet versions had been ordered by 27 customers.

The basic **MM.38** round is a two-stage solid-propellant missile fitted with four cruciform wings and four tail control surfaces. The missile is stored in a rectangular box-like container-launcher. Before firing the range and bearing of the target is determined by the launch platform's own fire-control system and stored in the missile's guidance system. The missile is then launched towards the target, a low-altitude inertially-controlled profile being flown throughout the cruise phase. At around 10 km (6.2 miles) from the target's estimated location the ADAC active radar seeker is switched on and the target acquired by the missile; the seeker then locks on and the missile descends to one of three pre-set sea-skimming altitudes, chosen according to the sea state and the target damage required. MM.38 operators include Argentina, Brazil, Brunei, Chile, Ecuador, France, Indonesia, Malaysia, Morocco, Nigeria, Oman, Peru, Philippines, Thailand, the UK and West Germany.

Improvements to the sustainer motor and container-launcher have resulted in the evolution of the larger **MM.40** variant. This has increased range, but also allows a larger number of rounds to be carried for the same space and weight occupied by the MM.38 system. Among operators of the MM.40 are Argentina, Colombia, Ecuador, France, Morocco, Qatar, Tunisia and the United Arab Emirates. The first variant to see action, however, was the air-launched **AM.39**. This version evolved from a modified MM.38 (called the **AM.38**) that incorporated a one-second ignition delay on the motor to allow the weapon to fall clear of the launch aircraft. The first AM.38 tests were conducted in April 1973. In 1977 the first test rounds of the shorter and lighter AM.39 were fired, with production starting in that year for the French navy and for export to Abu Dhabi, Argentina, Bahrain, Brazil, Iraq, Kuwait, Pakistan and Peru. The AM.39 was then successfully used by Iraq in the current Gulf War from Aérospatiale Super Frelon helicopters, sinking at least three Iranian warships and damaging or destroying a number of merchant vessels and oil rig platforms. The Argentinians subsequently used the AM.39 in the Falkland Islands war, together with the MM.38. The missiles fired from Dassault-Breguet Super Etendard fighters and crude shore batteries resulted in the loss of the destroyer HMS *Sheffield* and the merchant vessel *Atlantic Conveyor*, plus severe damage to the destroyer HMS *Glamorgan*. Follong the success of the Super Etendard/AM.39 combination, Iraq has leased five such aircraft from the French Aéronavale to attack Iranian oil industry targets located in the Gulf.

In the mid-1970s the French navy requested the development of an encapsulated submarine-launched version, the **SM.39**. In this version the missile is encased in a 5.8-m (19-ft) long capsule that weighs 1350 kg (2,976 lb) when loaded and is capable of being launched from standard torpedo tubes. Like the Sub-Harpoon the SM.39 is released from its capsule upon reaching the surface of the water, and then rapidly assumes the Exocet's sea-skimming flight profile. The French are due to equip their nuclear attack submarines and the conventional 'Agosta' class with the missile from 1985 onwards.

Specification
AM.38

Dimensions: length 5.21 m (17 ft 1.1 in); diameter 35.0 cm (1 ft 1.75 in); span 1.004 m (3 ft 3.5 in)

Weights: total round 750 kg (1,653 lb); warhead 165 kg (364 lb)

Performance: maximum speed Mach 0.93; range 42 km (26 miles)

Specification
AM.39

Dimensions: length 4.69 m (15 ft 4.65 in); diameter 35.0 cm (1 ft 1.75 in); span 1.004 m (3 ft 3.5 in)

Weights: total round 652 kg (1,437 lb); warhead 165 kg (364 lb)

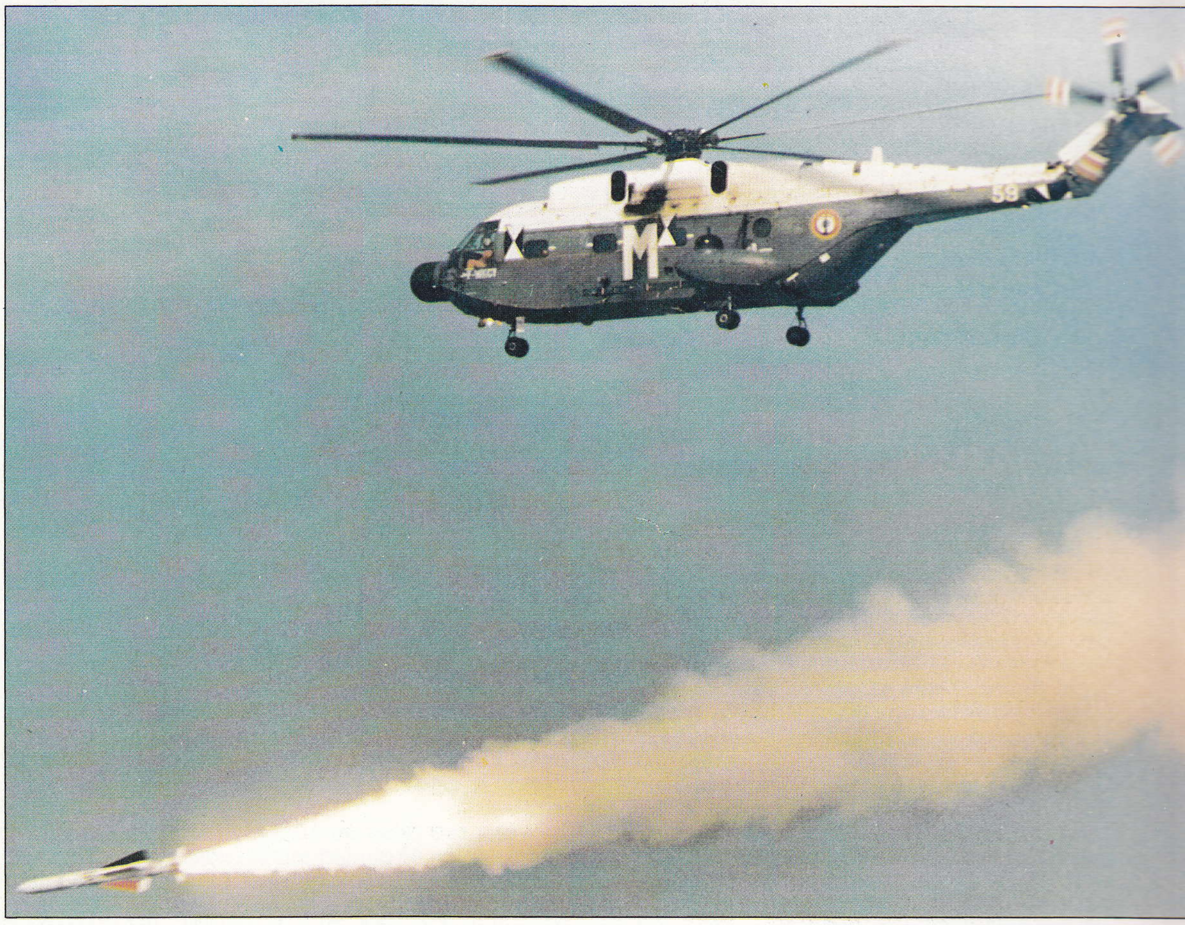
Performance: maximum speed Mach 0.93; range 50-70 km (31-43.5 miles) depending on launch altitude

Specification
MM.40

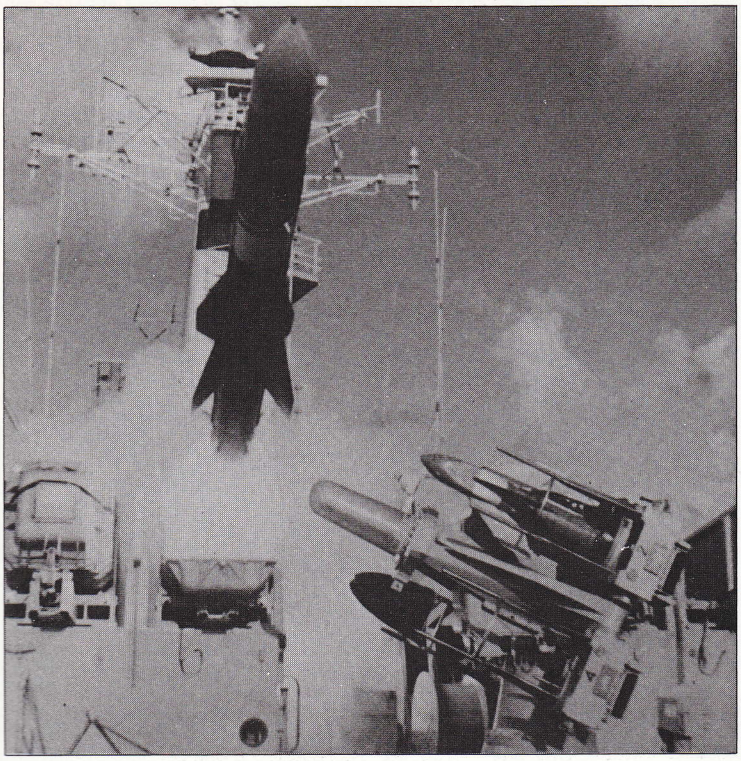
Dimensions: length 5.78 m (18 ft 11.55 in); diameter 35.0 cm (1 ft 1.75 in); span 1.135 m (3 ft 8.66 in)

Weights: total round 850 kg (1,874 lb); warhead 165 kg (364 lb)

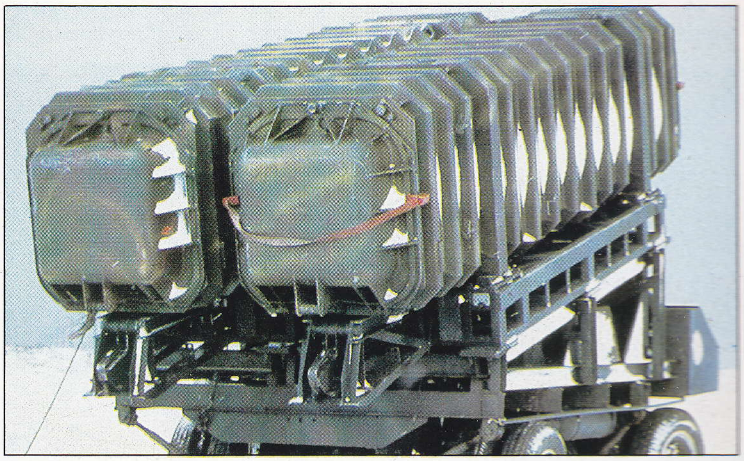
Performance: maximum speed Mach 0.93; range 65 km (40.4 miles)



The AM-39 air-launched Exocet missile is fired from an Aérospatiale Super Frelon helicopter of the French navy. It is this combination that the Iraqi air force has recently used to sink three large Greek merchantmen off the Iranian coast.



Left: An Exocet is launched from a Batch 2 'Leander' class frigate of the Royal Navy. Several of the Leanders have had their 114-mm (4.5-in) guns replaced by Exocets with an additional Seacat SAM launcher forward.



Above: Flown in by Argentine air force C-130 Hercules during May/June 1982, these container-launchers for MM.38 Exocets were removed from a warship and modified for launching from a trailer to act as an improvised coastal defence weapon for Port Stanley.

Anti-ship Missiles in the Falklands

The Falklands conflict saw the combat-testing of a number of major weapon systems against Western-style targets. While many were successful to a greater or lesser degree, the loss of HMS* Sheffield *and* Atlantic Conveyor *pointed to serious deficiencies in the Royal Navy's response to sea-skimming missiles.

The combat debut of the BAe Sea Skua anti-ship missile occurred in the early hours of 3 May 1982, soon after the Westland Lynx helicopters from HMS *Glasgow* and HMS *Coventry* had been ordered to search for two suspected Argentinian corvettes operating in the Total Exclusion Zone round the Falkland Islands. Shortly before they had to return to their ships for refuelling, the Lynxes picked up a contact on their radars. A Westland Sea King from the aircraft-carriers was sent to investigate this contact, but as it closed the target the helicopter encountered 40-mm anti-aircraft fire and was forced to turn away. At 0300 *Coventry* scrambled her Lynx again with orders to attack the hostile ship with Sea Skua missiles; the other Lynx (from Glasgow) was held in reserve. As soon as the helicopter was in range it ripple-fired its two Sea Skuas: after the impact of the second round the target, subsequently discovered to be the 835-ton converted tug *Comodoro Somellera*, exploded with a brilliant flash that was visible up to 40 km (25 miles) away. Immediately after this *Glasgow* launched her Lynx to search for survivors. The helicopter's Seaspray radar picked up a contact when the Lynx was some 100 km (62 miles) out from its parent ship, and the crew closed it thinking that it was the hulk of the first target. At a range of 9-10 km (5-6 miles) they suddenly came under anti-aircraft fire which forced the Lynx to dive from 915 m to 90 m (3,000 ft to 300 ft) and retreat to around 15-km (9.3-mile) range. At this point the two Sea Skuas were fired and observed to hit the target. The missiles blew off the bridge and part of the superstructure, leaving the *Alferez Sobral* (sister to the *Somellera*) with her captain and seven crew members dead. The vessel limped back to the mainland several days later.

Thirteen days later, at Port King in the Falklands, two BAe Sea Harriers from HMS *Hermes* bombed and strafed the cargo ship *Rio Carcarania.* Located again on 21 May, the ship was attacked by the Lynx from HMS *Ardent*, which hit the vessel with the single Sea Skua it fired. The attack was followed up by another, this time from HMS *Antelope*'s Lynx which scored two more Sea Skua hits and reported the target on fire and listing. A second look around midday by *Antelope*'s Lynx found the vessel to have disappeared.

An eighth Sea Skua was subsequently fired by HMS *Penelope*'s Lynx and hit its target, which was found to be a drifting hulk.

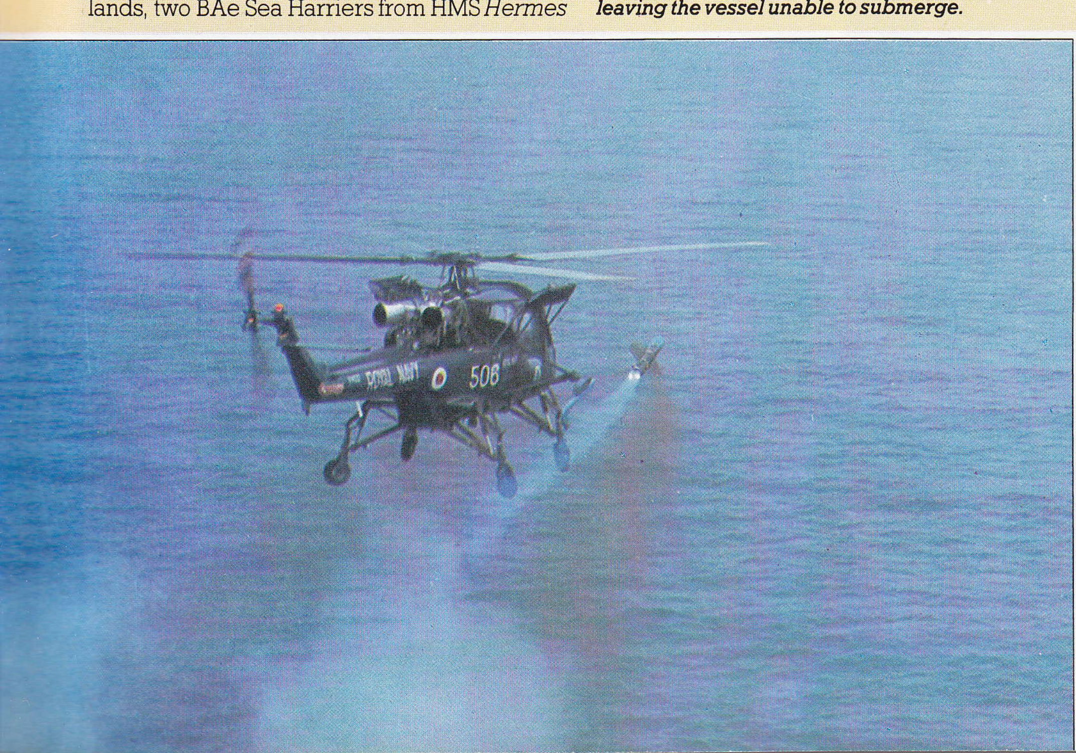
Exocet threat

However, by far the most malevolent missiles present on either side were the five AM.39 Exocets held by the Argentinian navy's 2nd Attack Squadron for its five Aérospatiale Super Etendard jets. Hastily brought into service with French technicians' help, these missiles were to cause the greatest shock to the British fleet.

Their first use came on 4 May, when HMS *Sheffield*, a Type 42 guided-missile destroyer, was located on radar picket duty by an Argentinian naval air force Lockheed Neptune maritime patrol aircraft. Four hours after the initial location report had been received three Super Etendards were launched from the Rio Grande air base. Two carried AM.39s whilst the third acted as the target designator. Flying at low level, the strike aircraft were refuelled on the outward and inward flights by the remaining two Super Etendards, which had in-flight 'buddy refuelling' packs on their fuselage racks. As they approached the target area the unarmed aircraft climbed to 150 m (490 ft) and at a range of 46 km (28.6 miles) discovered on his radar two contacts separated by 40° in azimuth. It was this aircraft that the *Sheffield* spotted on her radar as an unknown contact. In the meantime the target data had been passed to the missile-carriers, who launched their missiles at a range of 43 km (26.7 miles). The first incoming missile was not sighted until some 2 minutes 30 seconds after it had been launched and then only by two officers on *Sheffield*'s bridge. Less than six seconds later the AM.39 impacted at a point 2.4 m (8 ft) above the waterline on the level of deck two in the vicinity of the forward engine room. The impact of the missile and explosion of the warhead tore a hole some 3.05 m by 1.2 m (10ft by 4 ft) in the hull and knocked out the operations room, the fire main and all the ship's power supplies. The missile's unburned fuel set fire to the vessel's internal fittings, causing conflagrations and toxic smoke which rapidly spread throughout the ship. Whilst this was going on the second Exocet was successfully decoyed away from the second target, HMS *Yarmouth*, by defensive ECM and was seen to impact the water 300 m (330 yards) ahead of the ship. After the fires had been fought for several hours the *Sheffield* was finally abandoned, her surviving crew members being taken off by the *Yarmouth* and HMS *Arrow* in a rescue operation. On 9 May *Sheffield* was taken in tow first by the *Yarmouth* and then by a salvage tug, but on the following day she had to be scuttled because of bad weather.

One of the major causes of *Sheffield*'s loss to a missile was faulty intelligence, which had suggested that any Exocet attack by aircraft would be conducted by aircraft flying at medium altitude (to obtain maximum range for the missile) and not from low level. This defect in operational planning of defensive tactics was soon rectified by the issuing of orders both to use active jammers and to fire chaff when a missile attack was suspected. However, in this the Royal Navy succeeded too well, as the next attack revealed.

On 25 May, Argentina launched another two AM.39-carrying Etendards with Lockheed KC-130H tanker support for both the outward and inward legs. At a point 180 km (112 miles) north north east of the Falklands and while flying a circular course, the aircraft turned towards the south where, after climbing to 150 m (490 ft), they discovered a large target surrounded by a number of smaller ones in a circular pattern some 110 km (68 miles) north east of the islands. The attack was discovered by the Type 992 radar of HMS *Ambuscade,* which alerted the fleet. Every naval vessel then fired off its 16 ready-use Knebworth/Corvus chaff rockets and opened fire with guns and missiles. The ECM techniques were successful and the two missiles were decoyed away from the naval targets. Unfortunately, instead of ditching they locked on to the 13,000-ton *Atlantic Conveyor* store ship, a requisitioned merchantman without ECM, and which was carrying a significant part of the stores and helicopter heavy lift capability for the units ashore. Both missiles appeared to have exploded within the ship, causing several large fires amongst its cargo. The crew were forced to abandon ship, the vessel being left to drift and eventually to sink.

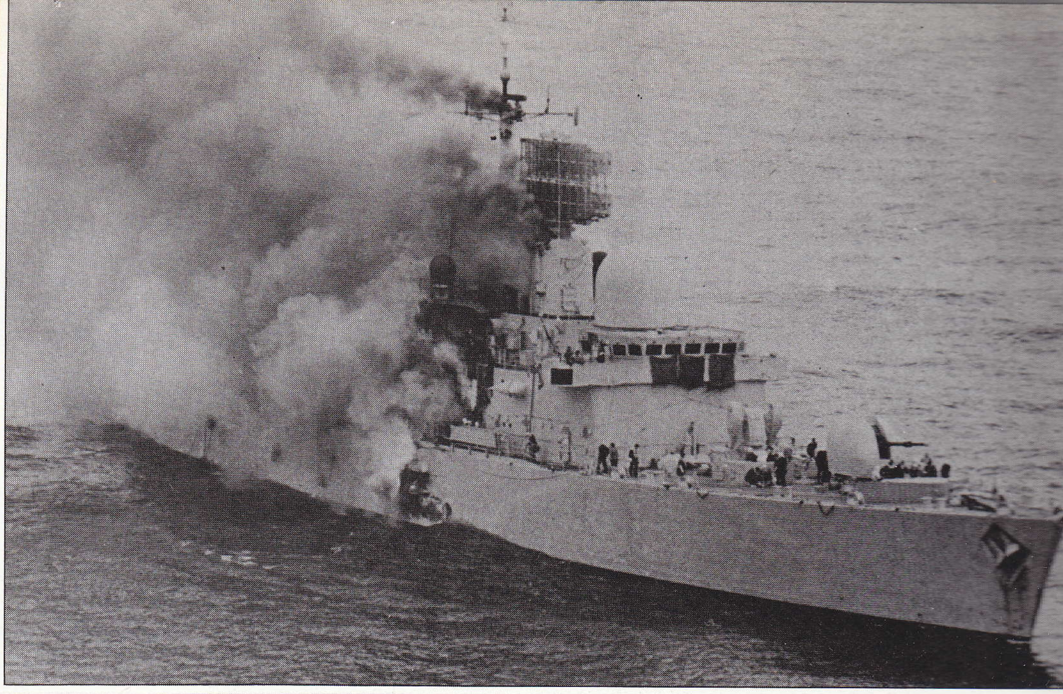


AS.12 missiles were fired by Royal Navy Wasps during the action with the Argentine submarine* Santa Fe. *The fin and pressure hull were damaged, leaving the vessel unable to submerge.

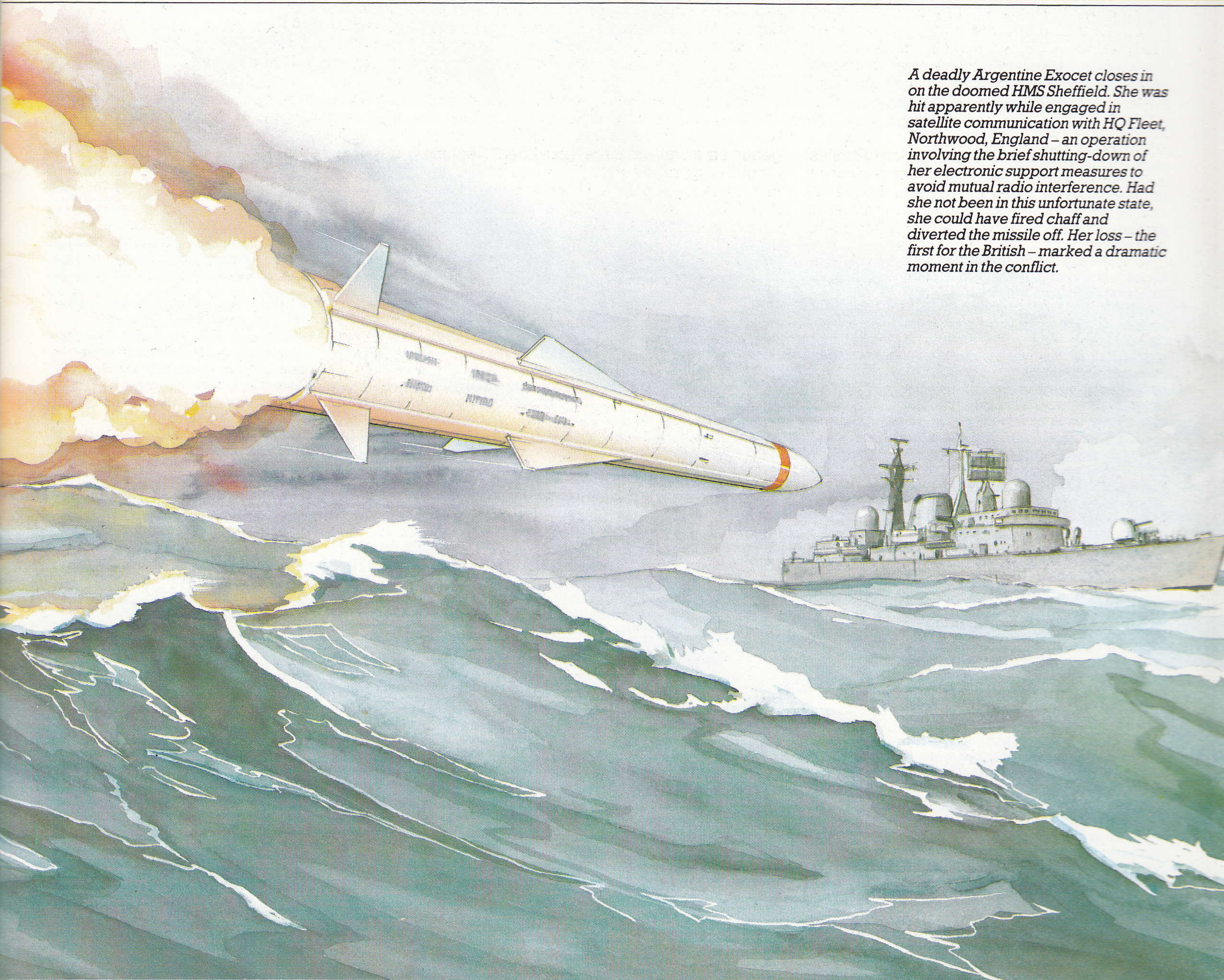
This one attack caused more problems in its effect on operations than any other during the Falklands war.

The final AM.39 attack came five days later, when two Super Etendards carrying the last missile joined with four McDonnell Douglas A-4C Skyhawks of the Argentinian air force's IV Brigada Aérea for a co-ordinated strike on HMS *Invincible*'s task group 320 km (200 miles) east of the Falklands. Both the KC-130H tankers were used to refuel the air group during the mission. The sole missile launched was destroyed by a direct hit from the 4.5-in (114-mm) gun of HMS *Avenger*, which also blew one of the Skyhawks out of the sky. A second Skyhawk was destroyed by a Sea Dart missile from HMS *Exeter*.

The final Exocet attack occurred on 12 June as HMS *Glamorgan* withdrawing after staying late on the gunline to provide much-needed gunfire support to 45 Commando RM. An MM.38 missile was launched from a makeshift coastal defence battery at a range of 29 km (18 miles): although both chaff and a Seacat missile were fired, the missile hit as the ship presented her stern to make a smaller target and exploded close to the hangar, destroying the Westland Wessex helicopter and causing several severe fires. Sturdy construction and extremely good damage-control measures saved the ship, although the vessel had the distinction of being the most severely damaged ship to stay afloat.



The Type 42 guided missile destroyer HMS Sheffield *was hit by an AM.39 Exocet fired from an Argentine navy Super Etendard on 4 May 1982. On comparison with trials photographs it was deduced that the warhead failed to explode.*



A deadly Argentine Exocet closes in on the doomed HMS Sheffield. She was hit apparently while engaged in satellite communication with HQ Fleet, Northwood, England – an operation involving the brief shutting-down of her electronic support measures to avoid mutual radio interference. Had she not been in this unfortunate state, she could have fired chaff and diverted the missile off. Her loss – the first for the British – marked a dramatic moment in the conflict.

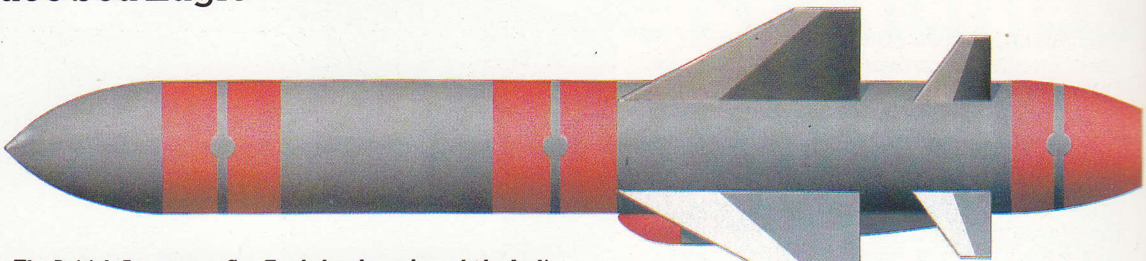
UK

British Aerospace Sea Eagle

The **P3T** was designed by British Aerospace to meet Air Staff Requirement 1226 issued in the early 1970s for an all-weather, night-capable, over-the-horizon range, fire-and-forget missile to replace the TV-guided AJ168 Martel missile. By 1977 the project had progressed to the definition phase with the launch trials taking place in November 1980. Full-scale development firings started in the following April, and in early 1982 a production contract was awarded for initial service deliveries in 1985. The **Sea Eagle**, as the P3T was named, is to arm two squadrons of maritime strike BAe Buccaneers (four missiles per aircraft), the BAe Nimrod maritime patrol force (two or four missiles per aircraft) and the Royal Navy's BAe Sea Harriers (two missiles per aircraft). In mid-1983 the Indian navy ordered the missile to equip a number of Westland Sea King Mk 42B helicopters that it is procuring. These helicopters will carry two missiles each.

The airframe of the Sea Eagle is basically that of the Martel but fitted with an underbelly inlet for the Microturbo TRI-60 turbojet propulsion unit. Guidance is initially by an onboard autopilot with the target's last known position and speed stored in its microprocessor memory; the pre-set cruise-phase flight profile and altitude are maintained by the autopilot and a Plessey radar altimeter, working through cruciform rear fins, whilst the terminal target-acquisition phase is undertaken by a highly sophisticated Marconi Space and Defence Systems active radar seeker. This guidance package allows both salvo attacks on a single target with the missiles attacking from different directions, and the overflying of one target so that a second and more desirable target can be attacked.

A ship-launched version of Sea Eagle is also being developed to meet a requirement from the Royal Navy for an MM.38 Exocet replacement on its surface ships. Known as the **Sea Eagle SL** (formerly **P5T**), the missile is carried in a lightweight container-launcher and will be fitted with solid-propellant booster motors to bring it up to flight speed. This arrangement also allows its launch from the Westland Sea King or Westland/Agusta EH101 helicopters. It is probable that other longer-range variants are also to be developed.



The British Aerospace Sea Eagle has been bought by India before it has actually entered service with the Royal Navy. India will operate it from a batch of new Westland Sea King helicopters.

Four test rounds on the wing pylons of a Hawker Siddeley S.Mk 2 Buccaneer. Two Sea Eagle-equipped Buccaneer squadrons will remain in service after the introduction of the Tornado to act as the main RAF anti-ship strike force in support of the Royal Navy.

Specification

BAe Sea Eagle

Dimensions: length 4.14 m (13 ft 7 in); diameter 40.0 cm (1 ft 3.75 in); span 1.20 m (3 ft 11.75 in)

Weights: total round 550-600 kg (1,213-1,323 lb); warhead 150-200 kg (331-441 lb)

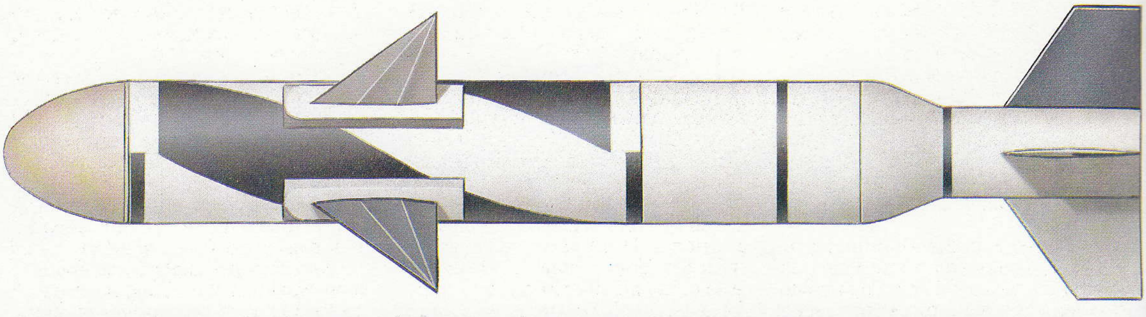
Performance: maximum speed Mach 0.9+; range 50-100 km (31-62 miles)

UK

British Aerospace Sea Skua

Designed as the new-generation helicopter-launched anti-ship missile for use against small and agile missile-armed surface craft at ranges in excess of their missiles, the **British Aerospace Sea Skua** (formerly **CL-834**) is currently replacing the obsolete Aérospatiale AS.12 wire-guided missile in Royal Navy service. Up to four Sea Skuas are carried by the RN's Westland Lynx, the target being illuminated by the helicopter's own frequency-agile I-band Ferranti Sea Spray surveillance and target-tracking radar to allow the semi-active homing seeker on the missile to pick up the reflected energy and so guide the weapon. The Sea Skua is treated as a round of ammunition and needs only minimal maintenance checks. The missile uses BAJ Vickers solid-propellant boost and sustainer motors when launched for powered flight. Its cruise height is pre-set to one of four sea-skimming altitudes according to the sea state encountered. Once the Sea Skua has been launched, its altitude is maintained by a British Aerospace-built TRT radio altimeter and an autopilot, working through the cruciform canard fins, until a position is reached near the target. Here a command instruction from the launch platform or from the missile's onboard guidance system orders the missile to climb to let the Marconi Space and Defence Systems semi-active radar homing head lock on.

The first trials using the complete



Treated as a round of ammunition, the Sea Skua missile was used in combat in the Falklands before it was actually declared operational. Surprisingly, no export sales have yet been announced for this excellent missile.

guidance system were conducted in December 1979. However, the missile was committed to combat during the 1982 Falklands war before it was officially declared operational. The missile was fired on four occasions, and scored eight hits out of eight rounds launched, sinking two Argentinian vessels and damaging two others. The semi-armour-piercing warhead proved quite effective in penetrating the targets' hulls and superstructure.

A surface-launched version (for use from small craft, hovercraft and coastal-defence batteries) is also under consideration. British Aerospace has also matched the missile to helicopters other than the Lynx, and has offered it as part of the armaments package of the ASW/maritime patrol version of the BAe 748 transport aircraft, the Coastguarder.

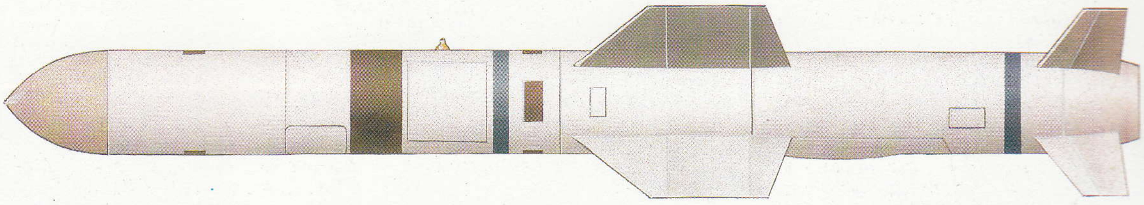
Specification

BAe Sea Skua
Dimensions: length 2.85 m (9 ft 4 in); diameter 22.2 cm (8.75 in); span 62.0 cm (2 ft 0.4 in)
Weights: total round 147 kg (325 lb); warhead 35 kg (77 lb)
Performance: maximum speed Mach 0.9+; range 20 km (12.4 miles)

The main carrier of the Sea Skua in Royal Navy service is the Westland Lynx. Up to four missiles can be carried, although a more normal load is two.

USA

McDonnell Douglas AGM-84A/RGM-84A Harpoon



The Harpoon in its many forms will become the mainstay of the US Navy's anti-ship missile inventory until the end of the century.

In 1967, following the sinking of the Israeli destroyer *Eilat* by an SS-N-2 'Styx', the US Navy began to show serious interest in developing its own anti-ship missile. The result was a formal proposal that led to the **McDonnell Douglas Harpoon**, but an interim alternative was also sought. This became the **Fireflash** SSM, based on the BQM-34A Firebee target and reconnaissance drone. By late 1971, however, the Fireflash was dropped as it was rapidly becoming a serious competitor to Harpoon rather than just an interim weapon. In the meantime Harpoon had begun life in the Fiscal Year 1968 programme as a 92.5-km (57.5-mile) range anti-ship missile (designated **AGM-84A**) suitable for air launch. By 1970 Harpoon's capabilities had been extended to ship-launch applications (as the **RGM-84A**), and in January 1971 McDonnell Douglas was selected as the prime contractor. The final variant, the encapsulated torpedo tube-launched **Sub-Harpoon** version for submerged launch from submarines, was started in 1972 and subsequently replaced the Submarine Tactical Missiles (STAM) programme that was cancelled in the following year.

The Harpoon development programme always emphasized simplicity and low technical risk. The missile, boosted by a solid-propellant rocket and sustained by a Teledyne CAE J402 turbojet, is usually fired in a pre-set Range and Bearing Launch (RBL) mode, turning on its Texas Instruments two-axis active-radar terminal only at the last moment to acquire the target without giving it time to instigate evasive measures. The frequency-agile radar can be set for large, medium or small acquisition windows that determine the range from the target at which the radar is activated. The smaller the window the more precise the initial target data must be, and the less the chance that the missile will be defeated by defensive ECM techniques in its terminal flight phase. Initial guidance in the flight is undertaken either by Lear Siegler or a Northrop three-axis strapdown altitude reference system with a Honeywell radar altimeter, working through cruciform rear fins. The alternative launch technique is the Bearing Only Launch (BOL) mode, in which the missile is fired on the target bearing and the radar is activated early in the flight, scanning 45° to each side of the missile's bearing to search for a target. If no target is acquired after a suitable time on the initial bearing, the missile switches to a pre-set search pattern. In either launch mode, once the target is detected and the seeker achieves a lock-on, the missile climbs rapidly in a pop-up manoeuvre and dives onto it. The newer Block IB and Block IC missiles now being built have a range increase of 15 per cent and a sea-skimming terminal attack profile. The latter was first adopted for the Royal Navy's Sub-Harpoon missiles. A Block II missile with a greater than 190-km (118-mile) range, variable flight profiles and improved ECM resistance is expected in the late 1980s for service in the 1990s.

It is reckoned that one Harpoon will destroy an 'Osa', 'Komar', 'Matka' or 'Nanuchka' class missile boat; two will disable a frigate; four will knock out a missile cruiser; and five will destroy a 'Kirov' class nuclear-powered battlecruiser or a 'Kiev' class carrier. The warhead is a 227-kg (500-lb) penetration-blast type fitted with time-delay contact and proximity fuses. On surface warships the Harpoon is either carried in its own cylindrical container-launcher or carried in the missile magazine of a Tartar/Standard SM-1 launcher. On some frigates two of the boxes in the ASROC ASW missile-launcher have been converted to fire the Harpoon. Aircraft normally carry two missiles under their wings. A new vertical-launch system for ships, capable of firing the Harpoon among other missiles, is currently under development for newer generations of USN vessels.

The Harpoon series is in widespread service with the USA and its allies, operators of the shipborne version including Australia, Denmark, Greece, Iran, Israel, Japan, the Netherlands, Saudi Arabia and Turkey. The USA deploys all three versions, and other operators of the air-launched model are Japan and the UK, while Sub-Harpoon is additionally found in the inventories of Australia and the UK.

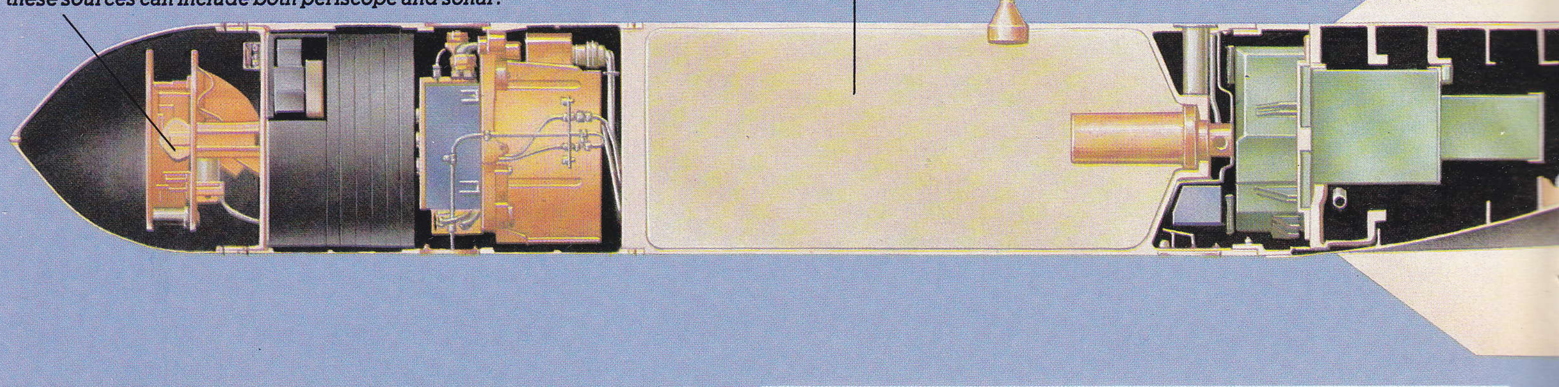
Specification

McDonnell Douglas Harpoon
Dimensions: length 4.58 m (15 ft 0.75 in) for RGM-84A and Sub-Harpoon, and 3.84 m (12 ft 7 in) for AGM-84A; diameter 34.3 cm (1 ft 1.5 in); span 91.4 cm (3 ft 0 in)
Weights: total round 667 kg (1,470 lb) for RGM-84A and Sub-Harpoon, and 522 kg (1,150 lb) for AGM-84A; warhead 227 kg (500 lb)
Performance: maximum speed Mach 0.85; range 120 km (75 miles)

Harpoon in Operation

Guidance *Beneath the plastic radome in the nose of Harpoon an active radar antenna searches for targets. Immediately behind a bulkhead the solid state radar electronics are coupled with a radio altimeter unit (essential in a sea-skimming missile). Behind that, Harpoon has a three-axis inertial guidance and attitude reference system, together with a general-purpose digital computer, which can be fed target information from the onboard radar as well as from external radar or ESM sources. In the sub-launched system, these sources can include both periscope and sonar.*

Warhead *Harpoon is armed with a high explosive warhead of almost 277 kg (500 lb). Fitted with a time delayed contact fuse, the missile is designed to penetrate the target before exploding, thus causing the maximum possible damage, as well as increasing the potential for secondary explosions. Harpoon is also being considered as a potential nuclear warhead carrier.*

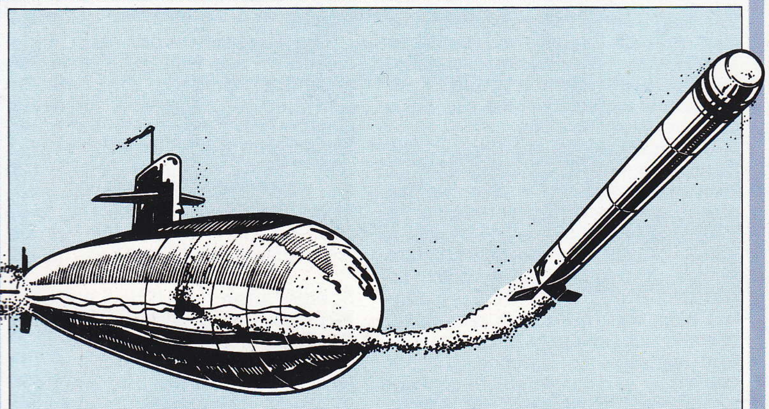


Designed as a simple low risk technological programme, the Harpoon anti-ship missile has developed into a versatile system capable of being launched from a ship, submarine or aircraft. Its simple electronics allow a rapid adaptation to most existing launcher and fire control systems, with the missile requiring no inputs from the launch platform once it has been fired. Targeting information can be provided from many sources including radar, sonar, ESM, third party and periscopes and is then fed into the guidance system, either automatically or manually. Once programmed, there are various launch modes and seeker search patterns that can be selected to give a high hit probability. The final terminal attack profile, however, varies with the missile model, target type and initial targeting data.

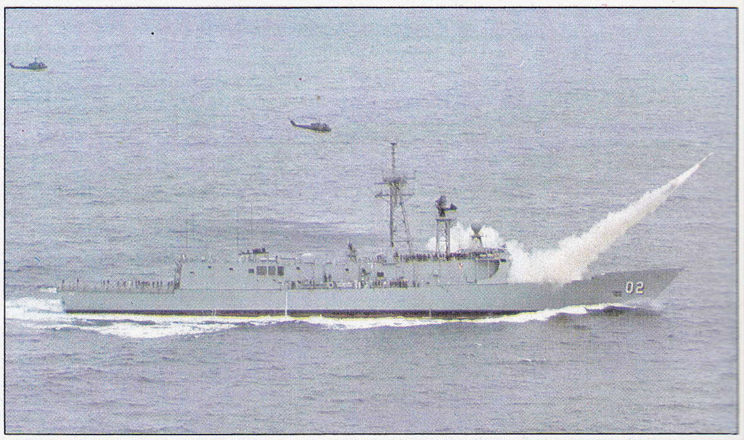
Since its operational debut, the Harpoon has demonstrated exceptional reliability and effectiveness in defeating the total spectrum of naval surface ship targets at long range in adverse weather conditions and in severe defensive countermeasure environments. Although it has only been limited combat service with Iran against Iraq, Harpoon has been chosen by most of the USA-orientated free world nations as their main anti-ship missile and is expected to remain in service throughout the 1990s.

A programme of system improvements has been initiated to progressively maintain and enhance Harpoon's ability as enemy anti-missile systems evolve. It is this system improvement capability, coupled with Harpoon's multi-platform flexibility and ease of installation, that is making it a popular choice in the world's navies. Within NATO navies interoperability has become of prime importance because of the cost factors involved in developing modern weapon systems. Within the US Navy it is, or will be, deployed on S-3 and P-3 ASW patrol aircraft, A-6, A-7 and F-18 attack aircraft, PHM hydrofoils, FF1052 and FFG7 frigates, and all the destroyer, cruiser and battleship classes. It will also equip the Permit, Sturgeon and Los Angeles classes of nuclear attack submarines. In addition the USAF Strategic Air Command will deploy Harpoon on the B-52 heavy bombers assigned to the sea control mission that will become a major operational task for the type.

Apart from the Exocet family the Harpoon is the only multi-role missile family in operational use, as the Soviets have not yet fielded a similar system. However, the absence of a nuclear-capable version is a matter of some concern in USN circles, although feasibility studies are known to have been carried out.



Above: Sub-launched Harpoon. The missile is fired from the torpedo tube in a capsule. This heads to the surface, where the capsule is ditched and the missile ignites its motor and launches.

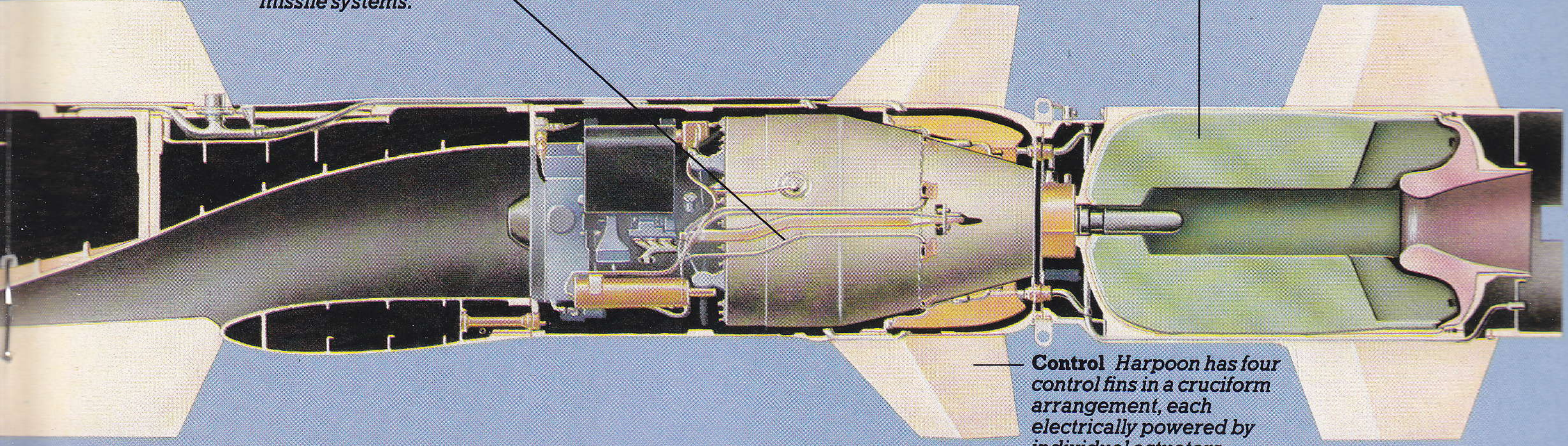


Above: Harpoon is fired from the Mk 13 launcher of HMAS Canberra.

Below: Launched from a submarine, Harpoon breaks the surface.

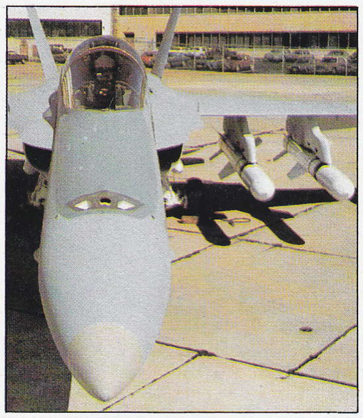
Sustainer *Harpoon is an air-breathing missile, with an air intake flush to the underside. The sealed fuel tank, containing about 45-kg (100 lb) of JP fuel, feeds a small 272-kg (600-lb) thrust jet engine. Also found in the sustainer section are the silver-zinc cells that provide power to the missile systems.*

Booster *Launching from ships or from submarines, Harpoon requires considerable power for a short time to reach cruising speed. The solid propellant rocket booster produces about 5443-kg (12000-lb) thrust for up to three seconds. Once exhausted, the rocket is discarded and Harpoon continues under jet power.*

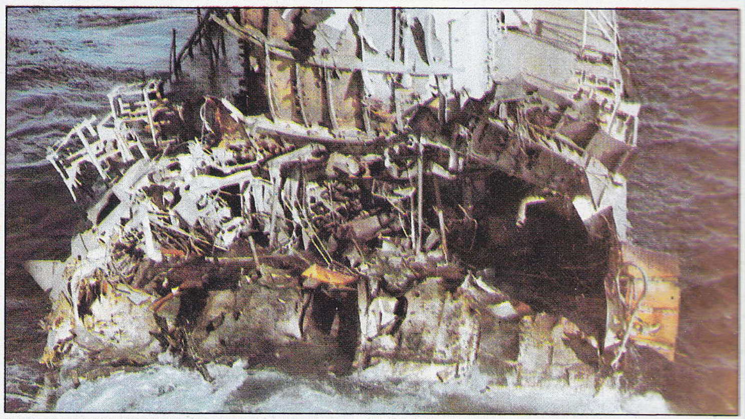


Control *Harpoon has four control fins in a cruciform arrangement, each electrically powered by individual actuators.*

Above: A 'Knox' class frigate fires Harpoon from a combined Harpoon/ASROC launcher.



Above: F-18 Hornets will carry Harpoon for the US Navy into the 1990s.

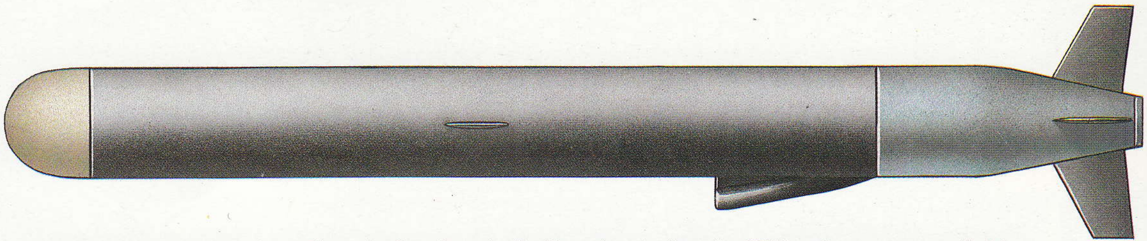


Above: Damage caused by explosion of the Harpoon's penetration-blast warhead.

Below: Harpoon follows a sea-skimming path once a target has been located.

USA

General Dynamics BGM-109 Tomahawk



Adapted from the strategic sea-launched cruise missile, Tomahawk gives the US Navy long-range anti-ship capability.

In November 1972, when interest was already evident in an extended-range version of the Harpoon, the decision was taken to develop a tactical anti-ship version of the strategic Sea-Launched Cruise Missile (SLCM). For the SLCM programme two competitive designs were funded, the **General Dynamics ZBGM-109** and the LTV ZBGM-110, both suitable for torpedo-tube launching. After a fly-off the **BGM-109 Tomahawk** was chosen in 1977 for full-scale engineering development. The tactical **BGM-109B** variant is similar in appearance to the strategic BGM-109A but is fitted with the conventional 454-kg (1,000-lb) warhead of the AGM-12C Bullpup B and the active-radar terminal seeker system of the Harpoon. An inertial guidance unit is also fitted for control of the cruise phase by means of the cruciform rear fins, and the missile adopts the same pop-up and dive manoeuvre used by the Harpoon Block IA missiles. The missile can be fired from surface ships or from submarines, and, after solid-propellant boost, cruises on a Teledyne turbojet. In the latter case the units of the 'Los Angeles' class of nuclear-powered attack submarines are to be fitted with a set of 12 vertical launch tubes in the space between the forward bow sonar sphere and the main pressure hull in order to conserve internal weapon space for ASW weapons. On surface ships Tomahawks will be carried in four-round armoured box launchers, or in the new vertical-launch system under development. The BGM-109B became operational aboard submarines late in 1982, whilst the first surface ships to be equipped will be operational in 1984. In order to make full use of the Tomahawk's over-the-horizon capabilities a long-range target-detection programme called 'Outlaw Shark' has been implemented to develop the techniques required.

A conventional land-attack version, the **BGM-109C**, was also developed for the US Navy, whilst two air-launched versions of a slightly modified and updated **Tomahawk II** model are under development for use against ship and other targets. These versions have the designations **BGM-109I** and **BGM-109K**, the former having inertial guidance with a combination of DSMAC II (Digital Scene-Matching Area Correlation Mk II) and imaging infra-red terminal homing, and the latter inertial guidance with imaging infra-red terminal homing.

Specification

General Dynamics BGM-109 Tomahawk

Dimensions: length 6.40 m (21 ft 0 in) for BGM-109B, 4.88 m (16 ft 0 in) for BGM-109I and 5.94 m (19 ft 6 in) for BGM-109K; diameter 53.3 cm (21 in); span 2.54 m (8 ft 4 in) for BGM-109B and 2.62 m (8 ft 7 in) for BGM-109I and BGM-109K

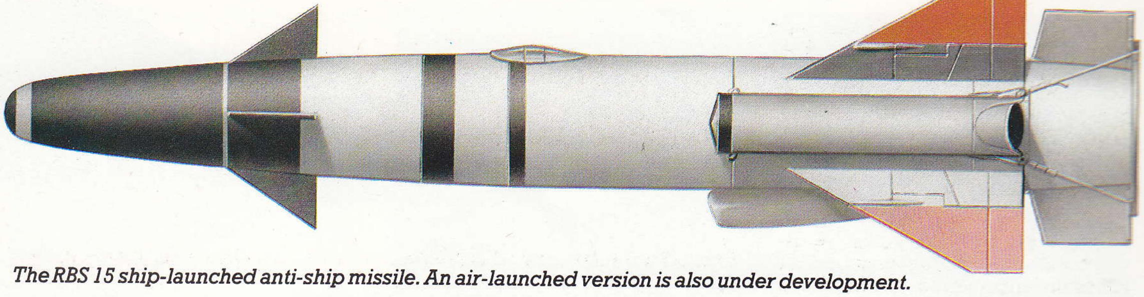
Weights: total round 1200 kg (2,645 lb) for BGM-109B, 1009 kg (2,225 lb) for BGM-109I and 1193 kg (2,630 lb) for BGM-109K; warhead 454 kg (1,000 lb) for BGM-109B, 295 kg (650 lb) for BGM-109I and 425 kg (937 lb) for BGM-109K

Performance: maximum speed Mach 0.7; range 350 km (217 miles) for BGM-109B, 560 km (348 miles) for BGM-109I and 510 km (317 miles) for BGM-109K

Vertical launch systems mean great savings in space and complexity aboard ship. Here Tomahawk is launched vertically at the Pacific missile test centre at Pont Mugu, California.

SWEDEN

Saab-Bofors RBS 15



The RBS 15 ship-launched anti-ship missile. An air-launched version is also under development.

The contract for the **RBS 15** was awarded in July 1979 to the Saab-Bofors Missile Corporation. The missile will arm the 'Spica' and later classes of missile craft in place of the Norwegian Penguin Mk II. In August 1982 Saab-Bofors announced a development contract for the **RBS 15F** air launched version. This is to be used to arm the Royal Swedish air force's fleet of Saab Viggen attack aircraft and the new-generation Saab JAS for anti-ship duties.

The RBS 15 is housed (with wings folded) in a container-launcher, and consists of three sections: the forward part contains the PEAB fully digital Ku-brand frequency-agile pulsed active radar seeker and its associated microprocessor and electronics, the middle portion contains the FFV blast-fragmentation warhead with both delay-action and proximity fuses, and the aft section houses the Microturbo TRI-60 turbojet sustainer. The RBS 15 is also fitted with strap-on booster motors located on the launch-phase stabilizer fins; these boosters burn for about three seconds and are then jettisoned. The RBS 15F has no booster motors. The flight altitude is controlled throughout by a radio altimeter, and course by an autopilot working through the cruciform rear wings.

A typical launch runs as follows. The ship's active and passive sensors are continually used to update the missile's launch parameters on an automatic basis. Once a target has been detected a missile is fired, the boost motors accelerating it to its subsonic sustained flight speed whereupon they are jettisoned. At its maximum speed the missile turns towards the target's predicted location, flying either a high- or a low-altitude pre-set cruise phase depending upon the presence of obstacles (such as islands) or not. At the end of a high-altitude phase the missile drops to the low altitude, where it carries out its search and target-acquisition functions. Once a lock-on has been achieved, then the final run-in to the target is flown at sea-skimming height. If no target is acquired the missile automatically self-destructs. Orders from Finland and Sweden have been received for the RBS 15.

Specification

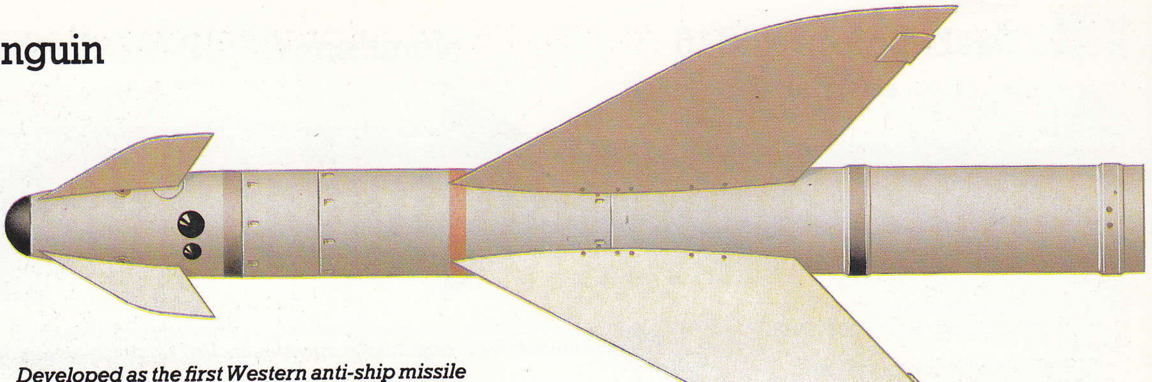
Saab-Bofors RBS 15 and RBS 15F
Dimensions: length 4.35 m (14 ft 3.25 in); diameter 50.0 cm (1 ft 7.7 in); span 1.40 m (4 ft 7.1 in)
Weights: total round 780 kg (1,720 lb) for RBS 15 and 598 kg (1,318 lb) for RBS 15F; warhead not known
Performance: maximum speed high subsonic; range 75 km (46.6 miles)

Right: An RBS 15 just after launch. The strap-on boosters are still in place and will be jettisoned after they burn out, when the propulsion is taken over by a turbojet sustainer motor. A blast-fragmentation warhead is fitted to create maximum damage within the intended target.

Below: 'Spica' class missile boats will be the major launch platform for RBS 15 in its ship-launched guise. RBS 15F will be air-launched from the Saab AJ 37 Viggen and from the new JAS 39 fighter when it is introduced.

NORWAY

Kongsberg Penguin



Developed as the first Western anti-ship missile system, the Penguin has undergone considerable improvement over the years.

Development of the **Penguin Mk I** took place from 1961 to 1970 as a joint effort between the Royal Norwegian navy, the Norwegian Defence Research Establishment and A/S Kongsberg Vaapenfabrikk. The requirement called for an anti-invasion weapon system compatible with the concept of small- and medium-sized ships operating in coastal waters. The Penguin was also the first anti-ship missile to be developed in the Western world. In 1972 the Norwegian navy completed its tactical and operational evaluation, and the Penguin Mk 1 went into service with the 'Storm' and 'Snogg' class missile craft. In 1974 a new development programme was initiated by the NDRE and Kongsberg under contract from the Swedish and Norwegian navies for the development of an improved **Penguin Mk II** missile. Development was completed in 1979, and the missile entered production for both navies. Apart from the shipborne verison there are also coastal-defence and helicopter-launched variants (with folding wings) of the Penguin Mk II. In 1980 Kongsberg was awarded a further contract to co-operate with the NDRE in the evolution of a **Penguin Mk III** version for use with the General Dynamics F-16 Fighting Falcon fighters of the Royal Norwegian air force. This version is now in advanced development and should enter service in 1987.

The ship-launched versions are carried in simple container-launcher boxes that weigh about 650 kg (1,433 lb) complete with missile. The box is located on a prepared deck mount that has an umbilical connection to the fire-control system. Once fitted the two-stage solid-propellant missile is ready for immediate launch. The Penguin employs inertial guidance for the cruise phase of its flight, initial target detection, acquisition and designation being carried out by the launch platform before the missile is fired. The missile is then launched on the target's bearing under control of its pre-programmed guidance system and cruciform canard fins. As soon as the missile enters the estimated target zone the infra-red seeker in the nose scans the area in front of the missile until the target is acquired, the seeker continuing to track the target while guiding the missile on an intercept course. The Penguin Mk III differs in having no booster motor and in the pulsed laser altimeter of the earlier versions being replaced by a radar altimeter. The warhead in all the versions is the Bullpup Mk 19 semi-armour-piercing model. Norway is a customer for all three Penguin models, other operators being Turkey for the Mk I, and Greece and Sweden for the Mk II.

Specification

Penguin Mk I and Mk II

Dimensions: length 2.96 m (9 ft 8.55 in); diameter 28.0 cm (11 in); span 1.40 m (4 ft 7.1 in)

Weights: total round 340 kg (750 lb); warhead 113 kg (250 lb)

Performance: maximum speed Mach 0.8; range 20 km (12.4 miles) for Mk I and 30 km (18.6 miles) for Mk II

Specification

Penguin Mk III

Dimensions: length 3.17 m (10 ft 4.8 in); diameter 28.0 cm (11 in); span 1.00 m (3 ft 3.4 in)

Weights: total round 360 kg (794 lb); warhead 113 kg (250 lb)

Performance: maximum speed Mach 0.9; range 40 km (25 miles) from a surface launch and 60 km (37.3 miles) from an air launch

Above: The coastal defence version of the Penguin Mk II.

Right: A Penguin being launched from one of the Norwegian navy's five 'Oslo' class frigates.

Soviet ship- and submarine-launched anti-ship missiles

This Soviet Union first investigated the concept of anti-ship missiles in the early 1950s as the equalizer to the American threat of the aircraft-carrier and its nuclear-capable strike aircraft. The first Soviet ship-launched missile subsequently deployed was the relatively unsophisticated **SS-N-1 'Scrubber'**, which had a limited service life in the Soviet navy. It was not until 1959 that the first of the widely-deployed missiles, the **SS-N-2 'Styx'**, was introduced to service. This has been improved progressively over the years, and is still in production today both for the Soviet navy and for export. The 'Styx' was designed to give small craft a firepower equivalent to that of a single battleship salvo but with a higher hit probability. Powered by a liquid-fuel rocket motor and armed with a powerful conventional warhead, the missile has seen extensive combat service with the navies of Egypt, Syria, Iraq, Vietnam, India and China, sinking a number of warships and merchantmen. However, when faced with sophisticated ECM defences the missile has not proved to be very effective.

In 1960 the Soviets introduced the large **SS-N-3 'Shaddock'** into service as its prime anti-carrier missile both for surface ships and for surfaced submarines. This turbojet-powered missile was initially fielded with no terminal homing system (the **SS-N-3C**) and a large nuclear warhead for use as a strategic strike weapon. The **SS-N-3A** submarine-launched and the **SS-N-3B** ship-launched anti-ship variants soon followed into service. A third-party system is required for over-the-horizon targeting with these weapons. In the late 1970s an improved SS-N-3B was introduced into service using technology from the follow-on **SS-N-12 'Sandbox'**, the eventual successor to the 'Shaddock'. Introduced into service in 1973 on several modified 'Echo II' class nuclear-powered cruise-missile boats, the missile was subsequently deployed on the 'Kiev' class carriers and is also apparently to arm the new 'Krasina' class cruisers. The 'Sandbox' uses a much improved 'Shaddock' propulsion system and is a surface-skimmer in its attack phase, unlike the 'Shaddock'.

With the advent of the 'Kirov' class nuclear-powered battle-cruiser and the 'Oscar' class nuclear-powered cruise-missile submarine, yet another new missile was introduced into service in the early 1980s. This is the **SS-N-19**, which is believed to be yet another improvement on the 'Shaddock/Sandbox' family with the probable addition of a home-on-jam capability.

The SS-N-3, SS-N-12 and SS-N-19 serve only with the Soviet navy, and while the SS-N-2C is reserved to the USSR, the SS-N-2A and SS-N-2B serve with all Soviet clients supplied with 'Osa', 'Komar' and 'Nanuchka' class craft.

Specification

SS-N-2 'Styx'

Dimensions: length 6.30 m (20 ft 8 in); diameter 75.0 cm (2 ft 5.5 in); span 2.75 m (9 ft 0.25 in)

Weights: total round about 3000 kg (6,614 lb); warhead about 500 kg (1,102 lb)

Performance: maximum speed Mach 0.9; range 46 km (28.6 miles) for SS-N-2A and SS-N-2B, and 74 km (46 miles) for SS-N-2C

Specification

SS-N-3 'Shaddock'

Dimensions: length 19.90 m (35 ft 9 in); diameter 86.0 cm (2 ft 9.85 in); span about 2.10 m (6 ft 10.7 in)

Weights: total round about 4,500 kg (9,921 lb); warhead about 1000 kg (2,205 lb) high explosive or 350-kiloton nuclear for SS-N-3A and SS-N-3B, and about 2300 kg (5,071 lb) 800-kiloton nuclear for SS-N-3C

Performance: maximum speed Mach 1.4; range 460 km (286 miles)

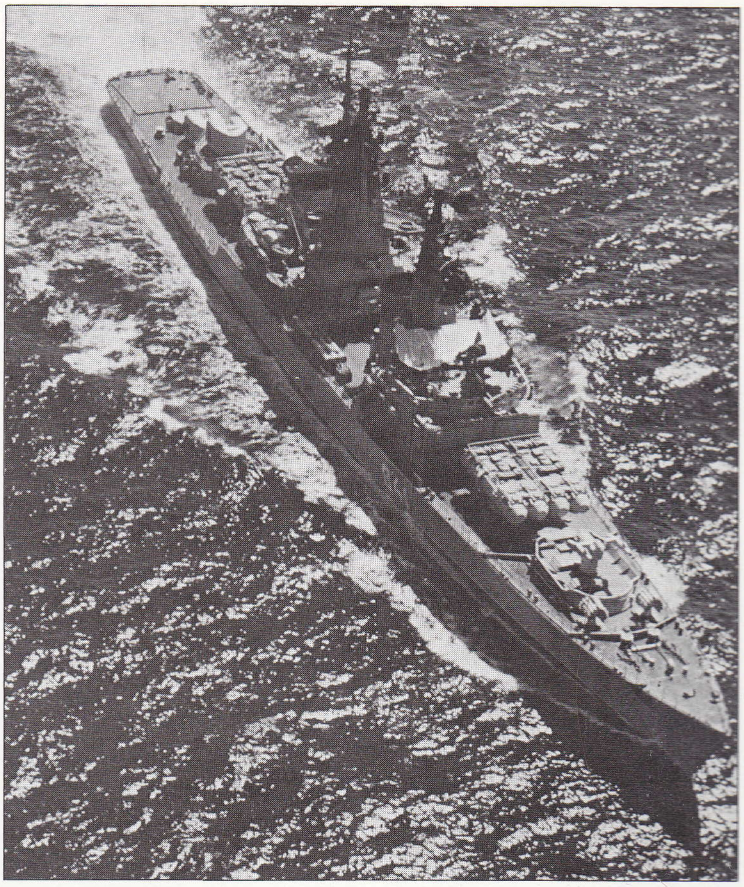
Specification

SS-N-12

Dimensions: length 10.70 m (35 ft 1.25 in); diameter 86.0 cm (2 ft 9.85 in); span about 2.50 m (8 ft 2.4 in)

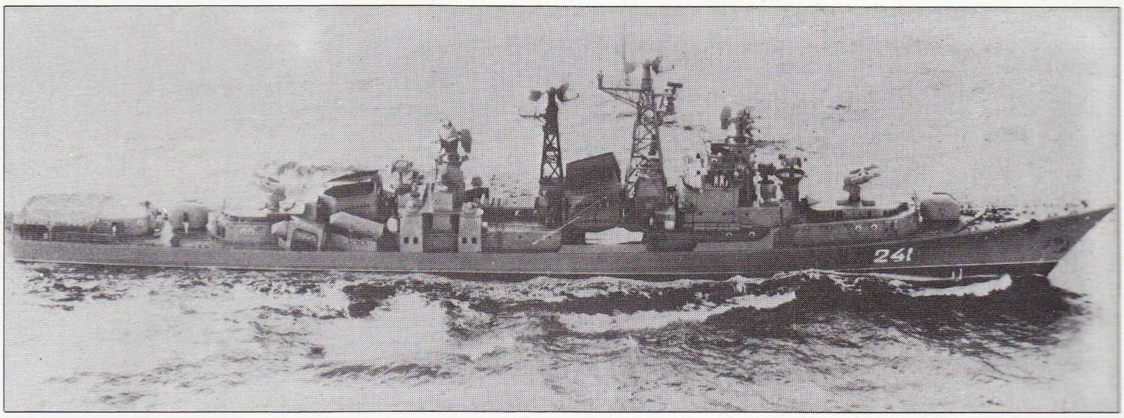
Weights: total round about 5,000 kg (11,023 lb); warhead 1000 kg (2,205 lb) high explosive or 350-kiloton nuclear

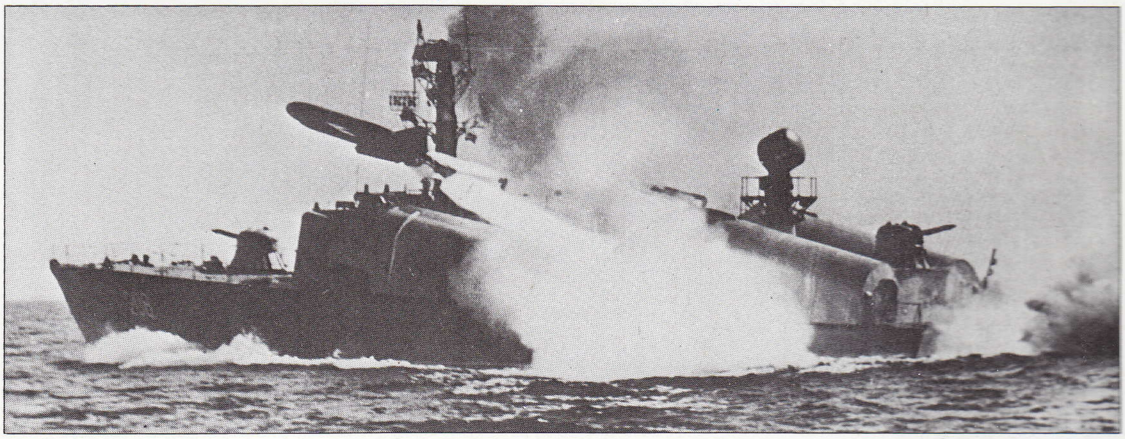
Performance: maximum speed Mach 2.5; range 560 km (348 miles)



Above: A 'Kynda' class cruiser armed with eight SS-N-3 'Shaddock' missiles. 'Shaddock' was the first missile to give the Soviet navy a blue-water anti-carrier capacity, and the 400-km (250-mile)-plus range missile arms many of the larger units of the Soviet fleet.

Below: A 'Kashin' Mod destroyer fitted to carry four of the launcher-containers for the SS-N-2C 'Styx', a longer-ranged variant of the original SS-N-2A.





Seen here being launched from an 'Osa' class fast patrol craft, SS-N-2 'Styx' (known as P-15 to the Soviets) ushered in the age of the missile-armed patrol craft. In Egyptian hands 'Styx' sank the Israeli destroyer Eilat *in October 1967, and India sank the Pakistani destroyer* Khaibar *in 1971. In spite of these missiles being outclassed by modern defences, they have also seen action with Syria, Iraq, Vietnam and China.*

USSR

SS-N-7 and SS-N-9 'Siren'

Introduced into service in 1968 and 1969 respectively, these two missiles have many components in common. Both are primarily anti-carrier weapons and are fitted with solid-fuel rocket engines. The **SS-N-7** is used solely in the pop-up mode from submerged 'Charlie I' and 'Charlie II' class cruise missile submarines, whilst the longer **SS-N-9 'Siren'** is used from both large missile craft and the 'Papa' and later 'Charlie II' class nuclear-powered cruise-missile submarines. In the latter case it is underwater-launched. Both are sea skimmers in the final phase of their attacks, the SS-N-7 flying at around 30-m (100-ft) altitude for its cruise phase, while the 'Siren' flies at the higher altitude of 75 m (245 ft) during this phase because it requires the extra height for effective use of its dual active radar and infra-red terminal homing seeker. The SS-N-7 has only an active-radar terminal homing system. The major difference in the two missiles, however, is the fact that the 'Siren' can use a third-party targeting and mid-course correction aircraft (or helicopter) to guide it in over-the-horizon engagements, whereas the SS-N-7 has to rely on the target data generated by the launch submarine's own sonars before launch as its sole guidance help. Both missiles are considered to be high-threat priorities by the US Navy.

In the early 1980s an improved version of the 'Siren' was fielded by the Soviets. Given the NATO designation **SS-N-22**, this new missile is carried by 'Sovremenny' class cruisers, and is believed to have a range of 150 km (93 miles) and be fitted with considerably improved electronics and propulsion system. Almost certainly a sea skimmer in operation, the missile is also thought to have a home-on-jam capability.

All three missile types are used exclusively by the Soviet navy.

Specification
SS-N-7

Dimensions: length 6.70 m (21 ft 11.8 in); diameter 55.0 cm (1 ft 9.66 in); span not known

Weights: total round about 3500 kg (7,716 lb); warhead 500 kg (1,102 lb) high explosive or 200-kiloton nuclear

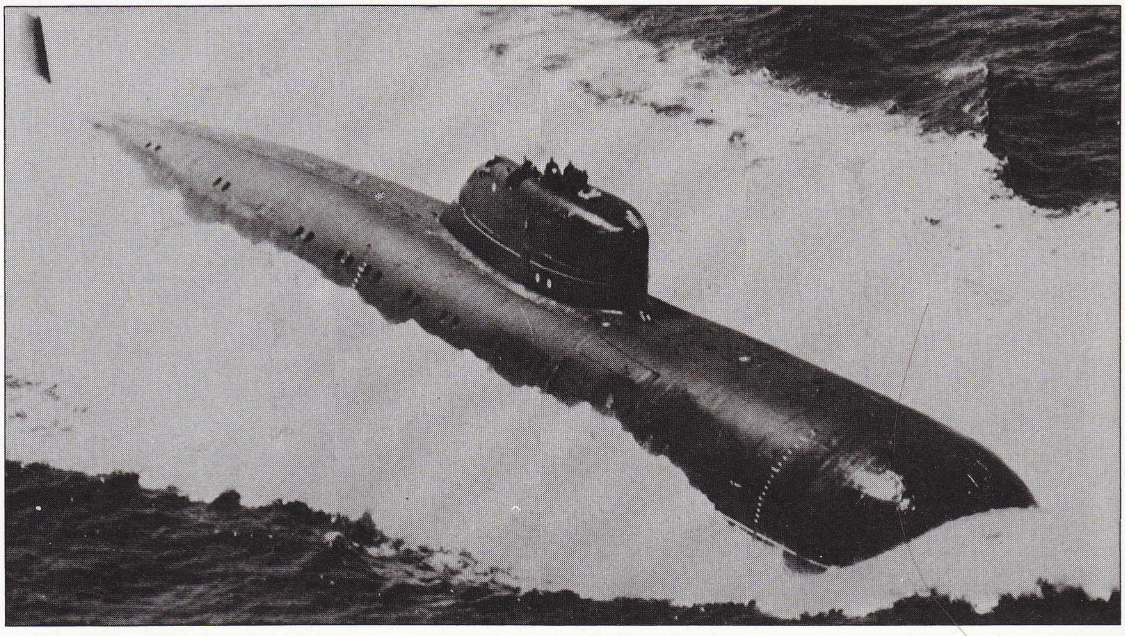
Performance: maximum speed Mach 0.95; range 55 km (34 miles)

Specification
SS-N-9 'Siren'

Dimensions: length 9.20 m (30 ft 2.2 in); diameter 55.0 cm (1 ft 9.66 in); span about 2.50 m (8 ft 2.4 in)

Weights: total round about 3000 kg (6,614 lb); warhead 500 kg (1,102 lb) high explosive or 200-kiloton nuclear

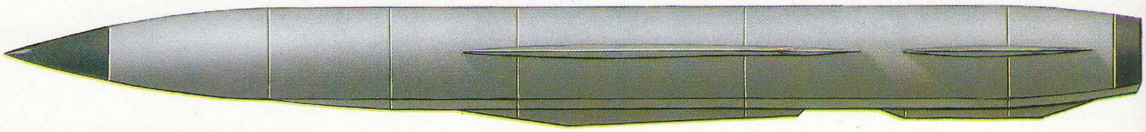
Performance: maximum speed Mach 0.9; range 110 km (68 miles)



The SS-N-7 submerged-launched anti-ship missile is carried by the 11 boats of the 'Charlie I' class of SSGN. With a range of 55 km (34 miles), it will be used in pop-up surprise attacks on high-value NATO surface ship units such as attack carriers.

USSR

Soviet air-launched anti-ship missiles

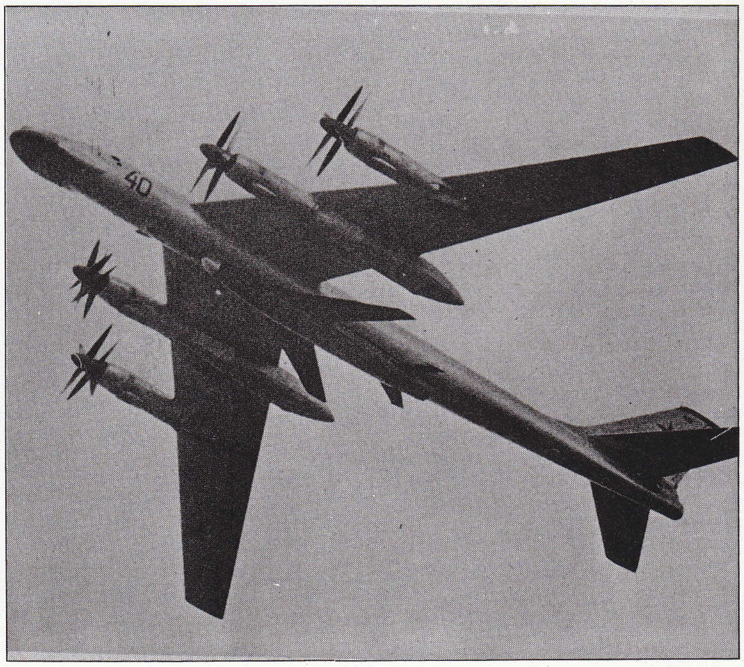


AS-4 'Kitchen' arms the Tupolev Tu-26 'Backfire' bomber.

The first Soviet air-launched anti-ship missile achieved operational status with the Soviet Naval air force in the late 1950s. Designated **AS-1 'Kennel'** by NATO, one such missile was carried under each wing of the Tupolev Tu-16 'Badger-B' bomber. Range was limited to about 80 km (50 miles) and the missile was a relatively unsophisticated beam-rider. The warhead was of conventional high explosive. Exported to Egypt and Indonesia, the missile is no longer in service with any of its users. In 1960 a new turbojet-powered missile was introduced into service, carried under the fuselage of the dedicated missile-carrying Tu-16 'Badger-C' bomber. Used only by the Soviet naval air force, the **AS-2 'Kipper'** is fitted with a conventional warhead and used solely as an anti-ship weapon. It has autopilot guidance with mid-course correction capability, and carries an active radar seeker suitable for use against large targets such as carriers. The missile remains in service today.

In the following year the Long-Range Air Force introduced into service the massive turbojet-powered aircraft-shaped **AS-3 'Kangaroo'** missile for strategic use. Designed for use against large area targets, the missile can also be used for attacks on groups of ships. Lacking any terminal guidance system, the AS-3 more than makes up for this by carrying an 800-kiloton thermonuclear warhead. Again, the missile remains in use on the Tupolev Tu-95 'Bear-B' missile-carrier.

Although seen in early 1961, the **AS-4 'Kitchen'** was not actually deployed with the Tupolev Tu-22 'Blinder-B' until 1965. The missile is powered by a single-stage liquid-fuel rocket, and was the first Soviet air-launched missile of multi-purpose nature. Used by the Soviet navy and Long-Range Air Force, the missile is available in anti-radar, anti-ship and strategic forms with a variety of homing systems to suit its role: all have inertial guidance, with active, passive or no terminal homing. Evidence of a continuing development programme was seen with the deployment of the Tupolev Tu-22M (or Tu-26) 'Backfire-B' bomber with one missile in a recessed fuselage weapons bay or with one missile under each wing. Evaluation of available photographs and comparison with those under the 'Blinder' suggest that there are two different families of AS-4 missiles, one de-



The massive AS-3 is a relatively simple missile, lacking any terminal guidance system. It is the size of a small fighter, and carries an 800-kt warhead for use against area targets.

veloped for the 'Backfire' alone (the underfuselage single-round type being nuclear-armed, and the missiles under the wings being conventional-warhead anti-ship or anti-radiation variants). The US Navy believes that the AS-4 is most dangerous when launched at high altitude for a high-level flight profile and very steep terminal dive onto the target.

The replacement for the 'Kennel' was fielded in 1966, when the **AS-5 'Kelt'** was first seen under the wings of the Tu-16 'Badger-G' bomber. Powered by a single-stage liquid-fuelled rocket, the AS-5 is similar in appearance to the AS-1 and is fitted with a conventional warhead. The guidance system is considerably improved, and both active-radar and passive-radar homing versions were used in combat by the Egyptians during the 1973 war against Israel. Out of 25 fired only five hit their targets, the rest being shot down by Israeli air-defence systems. The AS-5 is used by both the Soviet Naval Air Force and the Long-Range Air Force.

In 1970 the Soviet navy and Long-Range Air Force brought into service the **AS-6 'Kingfish'** missile to comple-

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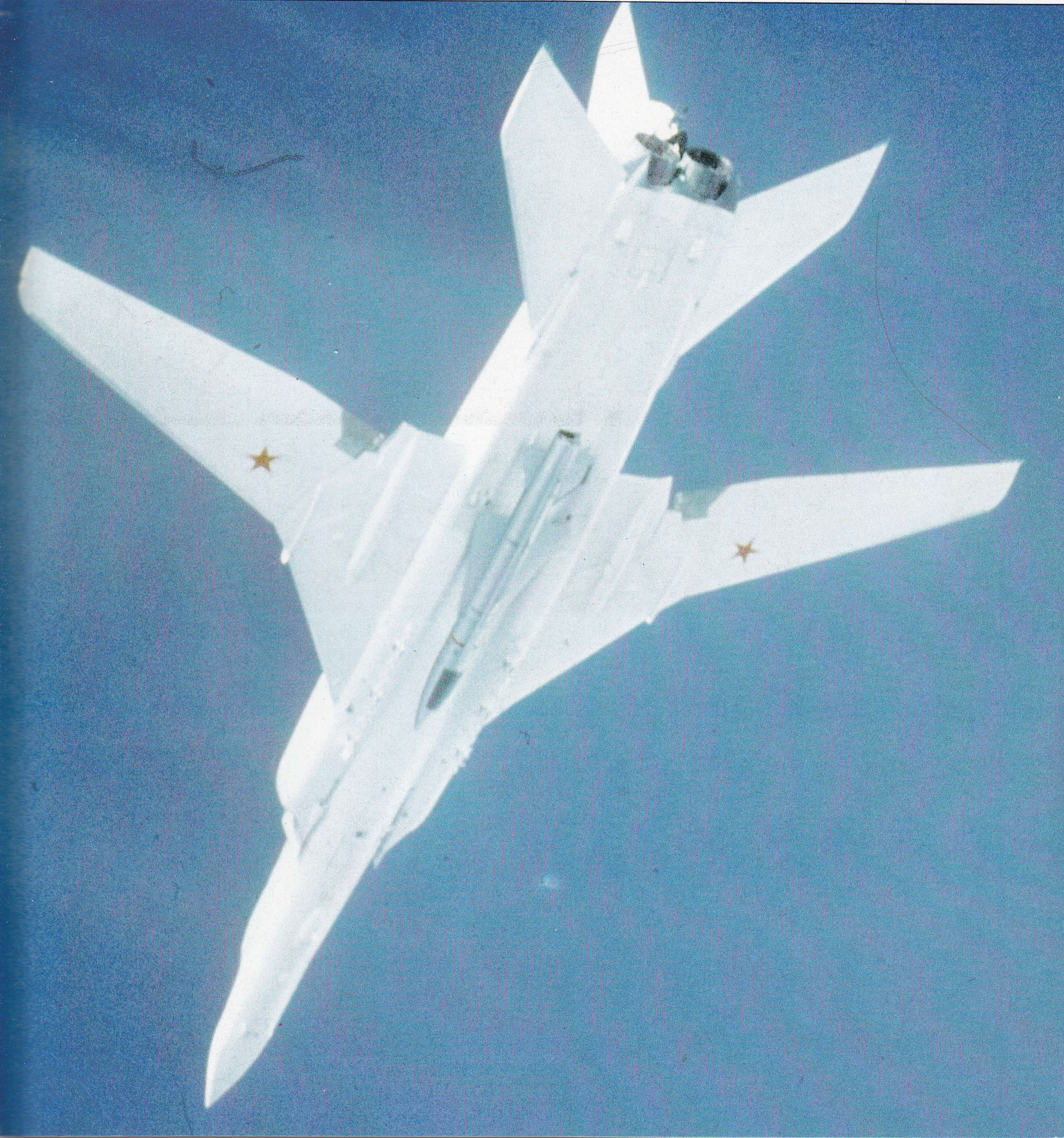


An AS-4 'Kitchen' derivative was developed for the Tu-22M 'Backfire' bomber. It is probable that this is the nuclear warhead armed version, although there are also conventional warhead-carrying variants for anti-ship and radar suppression missions.

NATO and the Soviet Naval Threat

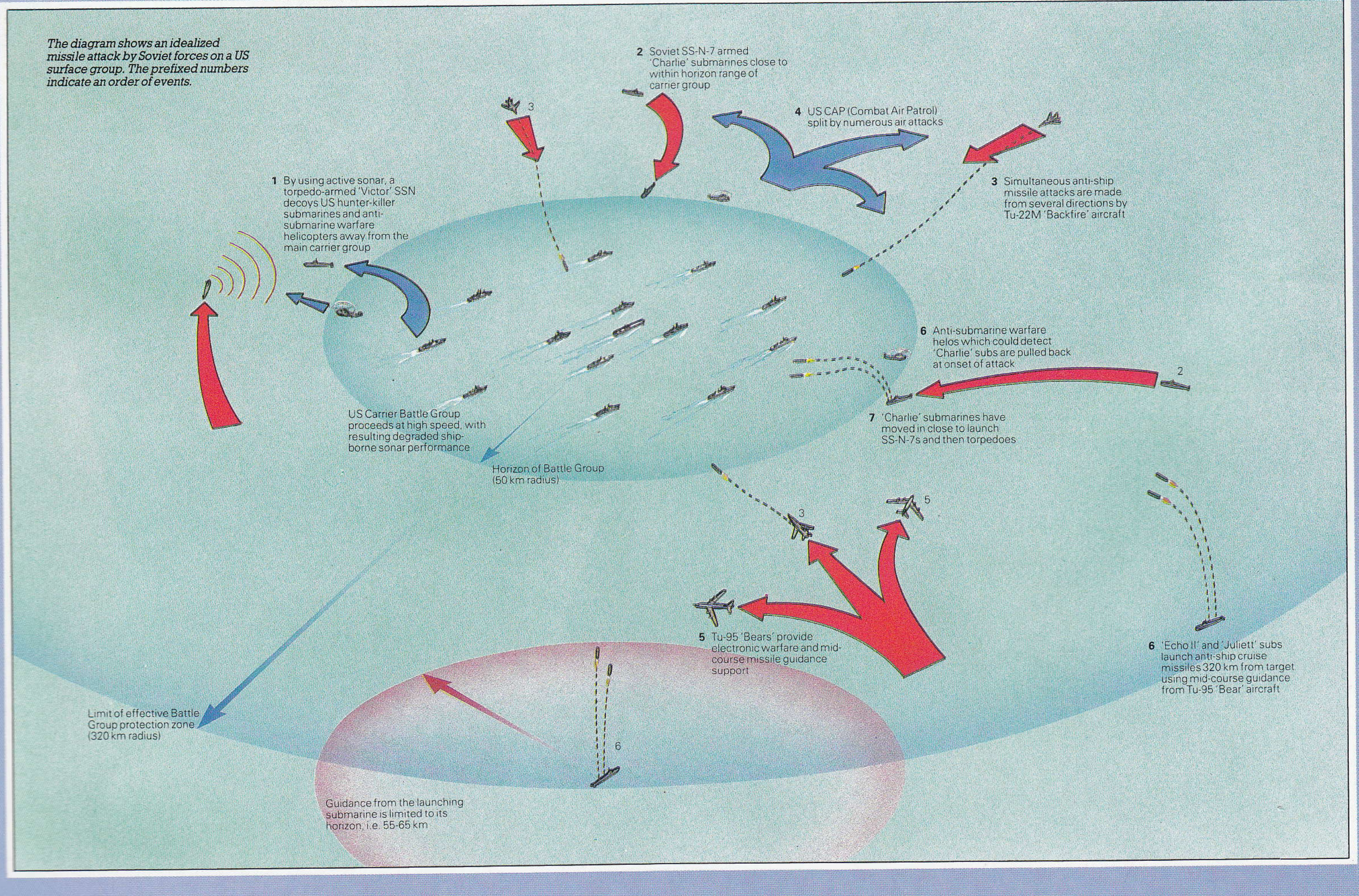
Since the mid-1950s the USSR has designed and built a wide variety of air-, surface- and submarine-launched anti-ship missiles. To make full use of these missiles' capabilities the Soviets have evolved over the years an overall strategy based on a single speedily developed and centrally co-ordinated surprise strike against surface fleet targets located in most of the world's oceans. The command and control of the forces involved is exercised from the operational headquarters of the Soviet navy, located near Moscow, via an extensive series of satellite and radio communication facilities which have considerable inbuilt redundancy. The problem of target-acquisition (and the tracking) of NATO vessels is solved by the Soviet Ocean Surveillance System (SOSS) which comprises the Soviet merchant, fishing and oceanographic fleets, naval surface and sub-surface units (including the familiar AGI intelligence trawler and the tell-tale shadowing warships), shore-based radio direction-finding stations, nuclear-powered active-radar ocean-surveillance satellites, passive signal intelligence-gathering satellites, manned space stations and spacecraft, naval and long-range air force aircraft, land-based over-the-horizon radars and fixed ocean bed acoustic-surveillance systems.

To screen the attack the Soviets will employ an ECM warfare plan that minutely details the inter-unit operations, the time of attack and the targets which need to be degraded electronically. All the active and passive ECM techniques used will also be co-ordinated with the selective destruction of the main defending radars by passive radiation-homing variants of the AS-4, AS-5, AS-6, AS-9, AS-11 and AS-12 air-to-surface missiles.

For the airborne missile-carriers the main ECM platforms used will be the Tupolev Tu-16 'Badger-H' chaff bomber, the Tu-16 'Badger-J' high-power barrage and spot aircraft, and the Antonov An-12 'Cub-C' jammer aircraft. The strike aircraft themselves carry self-defence spot jammers, chaff-launchers and decoy missiles that can screen missile salvoes.

In the case of the larger surface- and submarine-launched missiles (the SS-N-3, SS-N-9, SS-N-12, SS-N-19 and SS-N-22) a third-party system is usually required to aid in targeting, with mid-course correction and target-selection capabilities for targets located over the horizon and at extreme range. This task is normally undertaken by the Tupolev Tu-142 'Bear-D' maritime patrol aircraft or the Kamov Ka-25 'Hormone-B' target-designation helicopter. Fitted with their own long-range radars and passive direction-finding sensors, they provide the launch platform with the necessary radar picture to update the missiles in flight and to choose suitable targets. If no third party is available then it is believed that the missiles themselves can provide the necessary data by sending a picture seen by the radar seeker carried in the nose. More recent information suggests that the Soviets now have the capability of targeting their missiles with real-time data generated from their surveillance satellites.

The current doctrine of NATO fleet defence against the Soviet anti-ship missile threat rests on the concept of a series of three defensive zones. The outer zone (or outer air battle area) is contested by carrier-based fighter aircraft tasked primarily with destroying any incoming missile-carrying aircraft before they can launch their missiles. The defending fighters are normally on continuous combat air patrol (CAP) duties and will be augmented, whenever possible, by additional deck-launched interceptors. Both they and the CAP force will be vectored to intercept the hostile aircraft by an airborne early warning (AEW) aircraft, such as the Grumman E-2C Hawkeye, with its own long-range air-search radar and the command and control facilities required to control the fighters. The next belt is the middle zone (or surface-to-air missile zone) which uses the medium- and long-range area-defence SAMs of the fleet's escorts to engage any aircraft that have leaked through the fighter zone, and any missiles which have been launched. Typically this zone extends out to around 70-100 km (43.5-62 miles) depending on the range of the missiles. The final zone is the inner zone of hard- and soft-kill point-defence dystems. The former are the last-ditch weapons which defend against the aircraft and missiles that have penetrated both the outer defence zones, together with any short-range pop-up missiles that are launched from submarines that have penetrated the fleet's ASW perimeter. The soft-kill systems are the active jammers, expendable decoys and chaff rockets which rely on degrading the incoming missile's terminal homing unit or the aircraft's attack/navigation radar to such an extent that no effective lock-on can be achieved and the attack thus hits nothing. The hard-kill weapons are the close-in gun and missile systems such as the American 20-mm Phalanx 'Gatling' gun and the British Sea Wolf missile, which are designed for the automatic engagement and destruction of the missile or aircraft before it can damage the target vessel. The key to all three defensive zones is, however, the command, control and communication (C^3) system devoted to managing the weapon and sensor assets with which the fleet is equipped. An effective C^3 system will ensure the minimum losses of ships. If one of the elements is missing, such as AEW aircraft with suitable long-range fighters, then the fleet is liable to have its defences saturated and serious losses will occur. The Falkland Islands war of 1982 is fast becoming the classic example of such a situation where, although a CAP capability was present, the absence of any AEW aircraft allowed significant numbers of attacking aircraft to pass through the outer and middle defensive belts undetected to launch both missile and iron bomb attacks on ships of the Task Force, resulting in a number sunk and many others damaged. The inner zone battle also proved the necessity of ships having close-defence systems of modern design and not of World War II or even 1950s vintage. The presence of larger numbers of these systems would have certainly resulted in higher and totally unacceptable aircraft losses to the Argentinian air force and navy.

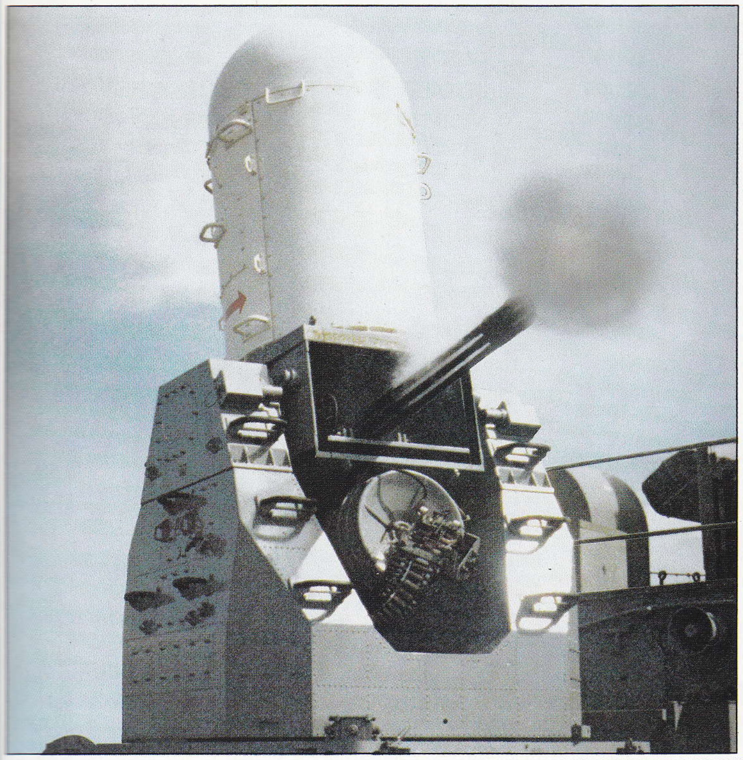


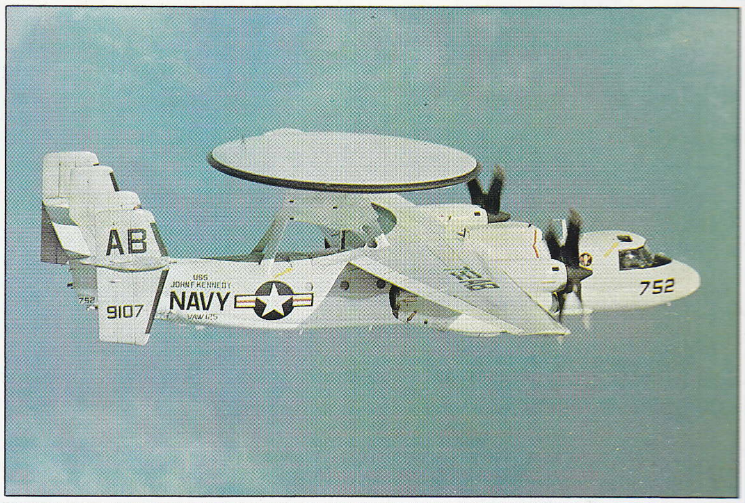
The diagram shows an idealized missile attack by Soviet forces on a US surface group. The prefixed numbers indicate an order of events.

2 Soviet SS-N-7 armed 'Charlie' submarines close to within horizon range of carrier group
3
4 US CAP (Combat Air Patrol) split by numerous air attacks
1 By using active sonar, a torpedo-armed 'Victor' SSN decoys US hunter-killer submarines and anti-submarine warfare helicopters away from the main carrier group
3 Simultaneous anti-ship missile attacks are made from several directions by Tu-22M 'Backfire' aircraft
6 Anti-submarine warfare helos which could detect 'Charlie' subs are pulled back at onset of attack
2
7 'Charlie' submarines have moved in close to launch SS-N-7s and then torpedoes
US Carrier Battle Group proceeds at high speed, with resulting degraded ship-borne sonar performance
Horizon of Battle Group (50 km radius)
3
5
5 Tu-95 'Bears' provide electronic warfare and mid-course missile guidance support
6 'Echo II' and 'Juliett' subs launch anti-ship cruise missiles 320 km from target using mid-course guidance from Tu-95 'Bear' aircraft
Limit of effective Battle Group protection zone (320 km radius)
6
Guidance from the launching submarine is limited to its horizon, i.e. 55-65 km

Above: The outer perimeter of US and NATO fleet defence is provided by carrierborne aircraft. The F-14 Tomcat and its long-range Phoenix missiles can protect an enormous area during its Combat Air Patrol (CAP).

Below: Long- and medium-range ship-launched missiles provide the middle layer of defence, typically to a radius of 100 km (62 miles) depending on the capability of the missile used.





Above: An essential component of NATO's defence is effective AEW. Provided by the Grumman E-2C Hawkeye for the US Navy, AEW was sorely missed by the Royal Navy during the Falklands conflict.

Below: A significant threat is posed by torpedo- and missile-armed submarines, but can be effectively countered by helicopters such as the Westland Sea King, which can carry both detection gear and weapons.

86
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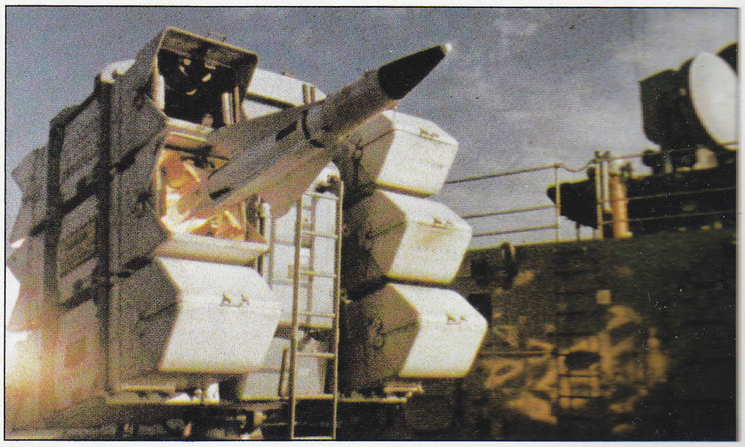
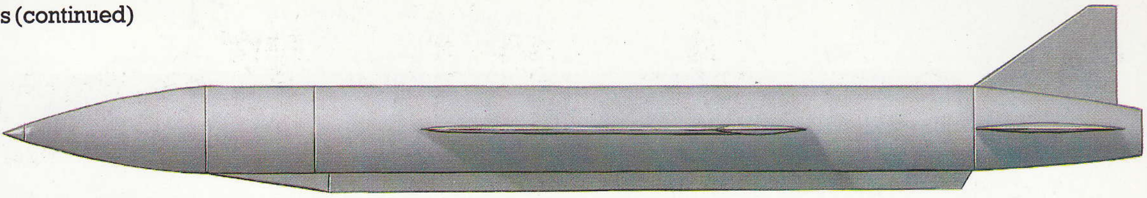


Left: Any missiles getting through come up against radar-directed multi-barrel cannon, capable of tracking both incoming missiles and outgoing cannon shells and adjusting the point of aim accordingly.

Above: Sea Wolf is a very fast, quick-reacting missile, designed to intercept enemy missiles in the last seconds before impact. Together with the close-in gun systems, it is a last-ditch measure.

ment the 'Kitchen'. The AS-6 is also a multi-role missile capable of the same roles as the AS-4 with the same types of guidance and homing. However, it is powered by a single-stage solid-propellant motor and is carried in pairs under the wings of the 'Backfire-B' Tupolev Tu-16 'Badger-C mod' and Tu-16 'Badger-G mod'. Like the 'Kitchen' it is considered a special threat by the US Navy. Both types are operated only by the USSR.



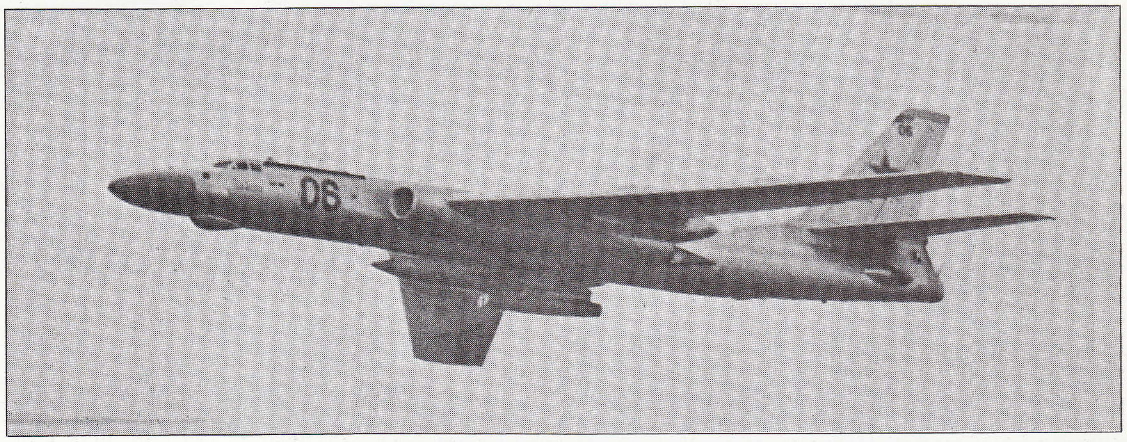
AS-6 'Kingfish' is a multi-role missile capable of carrying a nuclear warhead or a ton of high explosive.

Specification
AS-2 'Kipper'
Dimensions: length 10.0 m (32 ft 9.7 in); diameter 90.0 cm (2 ft 11.4 in); span 4.90 m (16 ft 0.9 in)
Weights: total round 4200 kg (9,259 lb); warhead 1000 kg (2,205 lb)
Performance: maximum speed Mach 1.2; range 185 km (115 miles) from a high-altitude launch

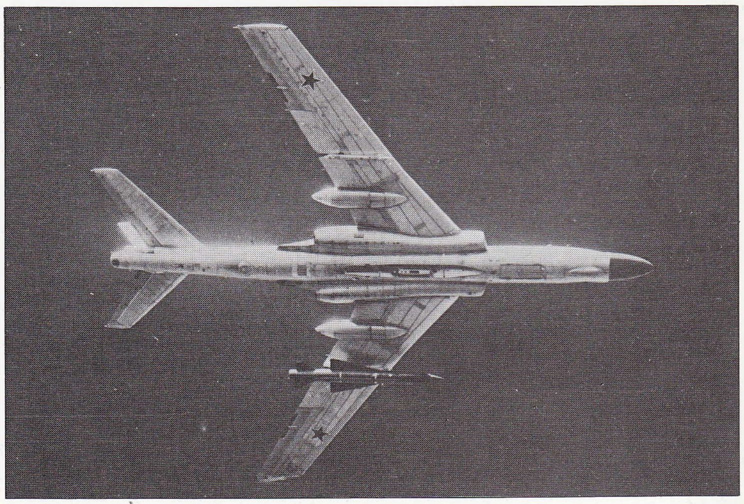
Specification
AS-3 'Kangaroo'
Dimensions: length 14.90 m (48 ft 10.6 in); diameter 1.85 m (6 ft 0.8 in); span 9.15 m (30 ft 0.25 in)
Weights: total round 11000 kg (24,250 lb); warhead 2300 kg (5,071 lb) 800-kiloton thermonuclear
Performance: maximum speed Mach 1.8; range 650 km (405 miles) from a high-altitude launch

Specification
AS-5 'Kelt'
Dimensions: length 8.60 m (28 ft 2.6 in); diameter 90.0 cm (2 ft 11.4 in); span 4.60 m (15 ft 1.1 in)
Weights: total round 3000 kg (6,614 lb); warhead 1000 kg (2,205 lb)
Performance: maximum speed Mach 1.2; range 230 km (143 miles) from a high-altitude launch and 180 km (112 miles) from a low-altitude launch

Specification
AS-4 'Kitchen'
Dimensions: length 11.30 m (37 ft 0.9 in); diameter 90.0 cm (2 ft 11.4 in); span 3.00 m (9 ft 10 in)
Weights: total round 5900 kg (13,007 lb); warhead 1000 kg (2,205 lb) high explosive or 350-kiloton nuclear
Performance: maximum speed Mach 3.5; range 460 km (286 miles) from a high-altitude launch and 300 km (186 miles) from a low-altitude launch

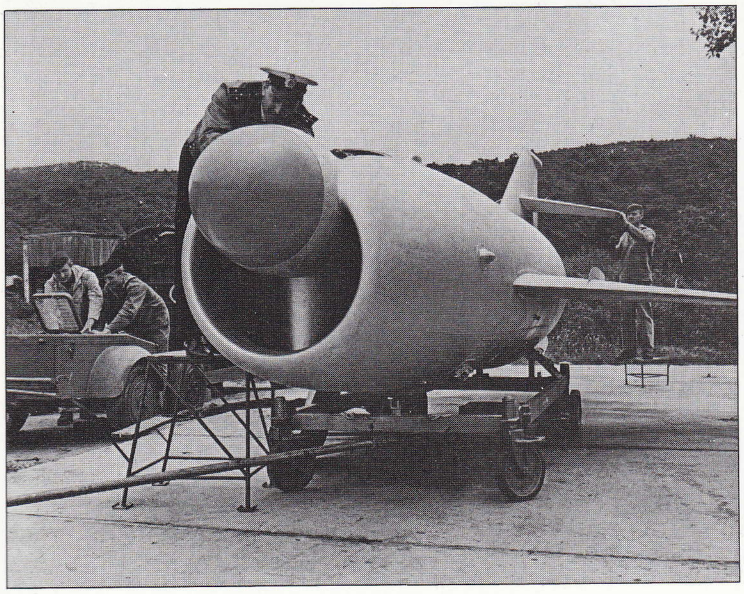


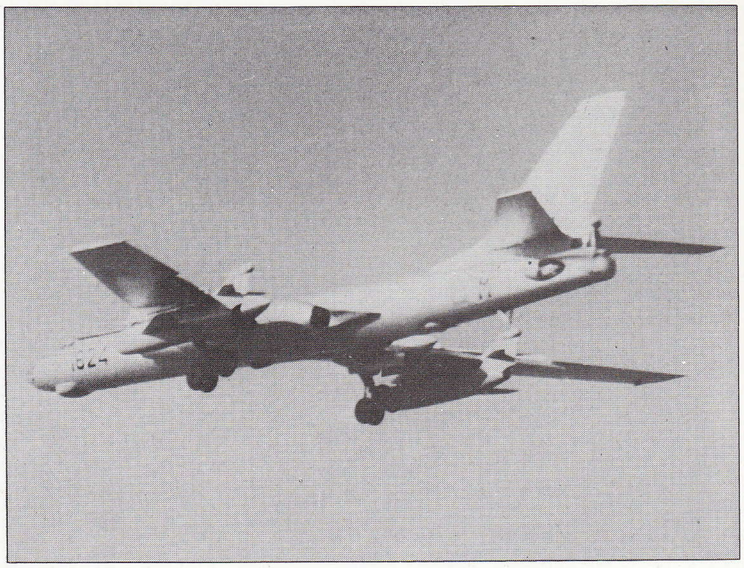
Above: AS-2 'Kipper' is used solely by Soviet naval aviation. Turbojet-powered, the missile has an active radar seeker suitable for use against large targets such as carriers, and has a range of 185 km (115 miles) from a high-altitude launch.



Right: AS-6 'Kingfish' is a Soviet missile of the 1970s, complementing the advanced AS-4 'Kitchen'. US sources consider 'Kingfish' would be used from high level, diving at Mach 3 onto the target.

Specification
AS-6 'Kingfish'
Dimensions: length 10.00 m (32 ft 9.7 in); diameter 90.0 cm (2 ft 11.4 in); span 2.50 m (8 ft 2.4 in)
Weights: total round 5000 kg (11,023 lb); warhead 1000 kg (2,205 lb) high explosive or 350-kiloton nuclear
Performance: maximum speed Mach 3; range 560 km (348 miles) from a high-altitude launch and 250 km (155 miles) from a low-altitude launch





Left: AS-1 'Kennel' dates from the 1950s. A simple missile, with a conventional warhead, the 80-km (50-mile) range 'Kennel' has been relegated to act as a coastal defence missile fired from the surface.

Above: AS-5 'Kelt' appeared in the late 1960s as a replacement for 'Kennel'. Rocket-powered, the AS-5 appears similar to its predecessor but is much more capable. However, it was not successful when used by Egypt in 1973.

French Air Force

Combat Units: Part 1

Photographed at their home base of St Dizier, this line-up of SEPECAT Jaguars illustrates the single-seat tactical support Jaguar A in the foreground, with a pair of two-seat advanced training Jaguar Es behind. These aircraft carry the bayard's helmet and plumes emblem of EC 1/7 'Provence'.

Occupying a unique position as the largest Western European air arm outside the NATO structure, l'Armée de l'Air (AA) reflects France's individualistic stance in matters of defence. A powerful force, the AA is nevertheless a valuable asset to the West, for despite France's withdrawal from NATO's military strength in 1966, the French government has made it clear that its armed services will fight alongside their neighbours the moment Europe comes under attack.

With global responsibilities stretching as far as the Pacific Ocean, the AA is one of the few major air forces in Europe to retain a true functional structure, comprising separate commands for Strategic Air Forces, Air Defence, Transport, Training and Telecommunications. A second rare feature, dating back to the time when aviation was in the hands of the army, is that combat and transport elements have as their basic unit the wing (*escadre*), each of which comprises two or three squadrons (*escadrons*) numbered as a function of the wing. (Two flights or *escadrilles* form a squadron, but these seldom warrant individual mention.)

Of the three combat commands here considered, the Commandement des Forces Aériennes Stratégiques (CoFAS) represents the air and surface elements of the French strategic nuclear force. A relatively new command, CoFAs was brought into being in 1964 and now controls two wings of Dassault Mirage IVA bombers, a missile squadron, an inflight-refuelling wing and a conversion unit. The headquarters of what is colloquially known as the 'Force de Dissuasion' is at Taverny, near Paris, but there is also a CoFAS II at Mt Verdun, Lyon, to assume control in the event of the prime site being put out of action.

Nuclear deterrence

The mainstay of CoFAS is the Mirage IVA, a scaled-up version of the original delta Mirage series, originally intended for high-altitude missions and now transferred to the low-level role with a single 70-kiloton AN 22 free-fall nuclear weapon. Delivery of 62 Mirage IVAs was completed in 1968. Some of the survivors have reconnaissance capabilities, whilst the balance of the force is assigned to five squadrons, each of four aircraft, a training unit and a reserve.

Most of the Mirage IVAs will be phased out during the 1980s, but 18 are in the midst of an upgrading programme to Mirage IVP (Pénétration) standard, involving fitment of improved radar and other new navigational avionics, as carriers for the ASMP (Air-Sol Moyenne Portée) 150-kiloton nuclear stand-off weapon, which will enter service in 1987. The 18 Mirage IVPs will remain in use until 1996, when their duty will be assumed by the projected SX ICBM.

A successor to the remainder of the Mirage IVA force is already in the flight-test stage in the form of the Mirage 2000N (Nucléaire), a two-seat version of the fighter with a strengthened airframe for low-level penetration and with Antilope V terrain-following radar. A requirement exists for 85 of these aircraft to be funded before the end of 1988 (the first 15 of which were authorized in 1983) and these, too, will receive the ASMP from 1988 onwards.

Like their predecessors, the Mirage 2000Ns may be refuelled in flight by the 11 remaining Boeing C-135Fs, which serve in three squadrons and have been modified for probe-and-drogue replenishment via the standard USAF 'flying boom' under the rear fuselage. The C-135Fs are to be re-engined with CFM-56 turbofans to extend their service lives beyond the end of the century.

France's intermediate-range ballistic missile deterrent is also operated by the AA and housed in two groups of nine silos, each, on the Plateau d'Albion near Avignon. Here, the 1er Groupement de Missiles Stratégiques has just completed a modernization programme involving installation of S3 missiles (1-megaton warhead) as replacements for the shorter-range S2s. These are to be replaced by the SX, with intercontinental-class range, around the year 2000.

Potent tactical force

Nuclear capability is also possessed by the Tactical Air Command (Commandement Aérien Tactique, or CATac), whose principal element is 1 CATac with HQ at Metz, while 2 CATac (HQ at Nancy) is the air component of the tri-service Force d'Intervention and is built up in an emergency from CATac squadrons on an 'as required' basis, having only two SEPECAT Jaguar squadrons under its peacetime control. Six wings, comprising 19 Squadrons, are allocated to tactical duties, those primarily assigned to the Tactical Nuclear Force (Armament Nucléaire Tactique, or ANT) carrying the AN 52 15-kiloton weapon.

Dassault Mirage IIIEs predominate in the force, those of EC 4 being nuclear-tasked, whilst EC 3 is engaged in defence-suppression duties (with Martel anti-radar missiles) and EC 13 is strike-configured. The last mentioned is of note in having two squadrons of Dassault Mirage 5Fs in its complement, these having found their way into AA service as a result of an embargoed Israeli order.

The versatile Jaguar A takes many parts: the one squadron in EC 3, for example, carries Martels and has secondary low-altitude air superiority and close-support roles. Eight more Jaguar squadrons are tasked with nuclear strike, ECM/jamming, conventional strike or rapid deployment, deliveries having comprised 160 Jaguar As and 40 two-seat Jaguar E models.

Dassault-Breguet Mirage F.1s entered CATac service in 1983, when the phase-out began of the Mirage IIIR and Mirage IIIRD reconnaissance aircraft in service with ER 33. The Mirage F.1CR, 64 of which are required, has been specially adapted for the reconnaissance role, carrying internal sensors and a range of centreline pods according to the demands of individual missions. Two of ER 33's squadrons have a secondary attack capability.

Replacement of the Jaguar and Mirage III is programmed to begin in 1966 with first deliveries of Dassault's ACF/ACT (Avion de Combat Futur/Avion de Combat Tactique), of which a technology demonstrator (the ACX) will fly late in 1986. It may transpire, however, that before the mid-1990s, CATac will receive some Mirage F.1s displaced from air defence by the Mirage 2000, allowing an earlier phase-out by some (by then) elderly Mirage IIIEs. The UK and West Germany are currently discussing a joint 'Eurofighter' programme with France, and this may lead to a multi-national aircraft, although such ventures are notoriously difficult to arrange in view of differing national requirements, and the AA may, after all, receive a wholly indigenous ACF/ACT.

To be continued

With approximately 252 Dassault-Breguet Mirage F.1s in service with the Armée de l'Air, the type provides France's primary all-weather interception force as well as fulfilling reconnaissance duties in its F.1CR configuration. Shown here is an F.1C-200 with permanent inflight-refuelling probe.